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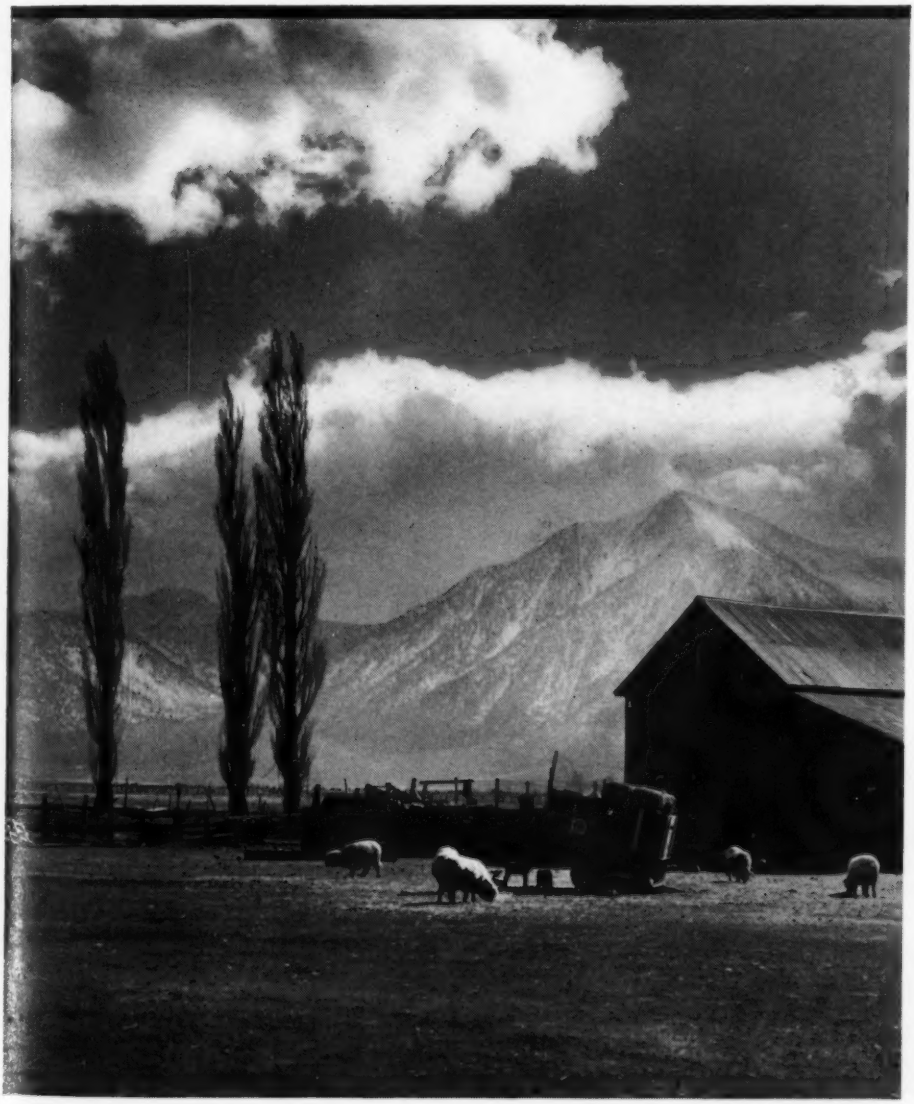

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Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: 1155 16th Street, N. W., Washington 6, D. C.

VOLUME XXXIII NO. 9

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"Good to the Last"

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Retired but . . .

No Quitter!

Jeff McDermid

OF all the habits of a long lifetime, top rank among those most difficult to shake off goes to the "American Way of Life," which usually includes a love of work for the work's sake, a fetish for regularity and consistency, and a compelling desire to "stay on the job" as one comes closer to the customary or required "time of retirement." But the field of opportunity is wide for men of good will, and so much depends upon the reason for retirement, the circumstances surrounding it, and the physical condition of the man himself that a dealer in mushy platitudes and copybook mottoes must beware and discriminate lest he offend in dishing out advice.

When we were young, as you perhaps still recall, we also hated the words "quit" and "retire," that is, except for the end of a long schoolday or the close of an irksome chore. Young Americans always shrink from quitting their playtime diversions and protest the admonitions of elders to retire for the night.

I think that persistent opposition of the young toward any quitting or retiring from activity and enjoyment grows on one through the years and animates much of our thinking even after there are no longer any presiding authorities to govern our coming and going and our periods of zest and rest. I have heard tell that Europeans and tropical dwellers alike have a different ruling passion in respect to labor and leisure. In the one case by custom and in the other by climate, many of them

take naturally to repose and retirement, to siestas and idle whimsies. Indeed, they go so far as to chide and scoff at us Americans for being so enthralled with our desks that we miss the world's delights and wind up too weary to take up an avocation when our vocation itself has run its course.

During my writing career I have had occasion at times to take notes on the achievements of some worthy man's life so that a suitable "work obituary" might be prepared to give him proper recognition and satisfaction in the field from which he was about to "retire." Invariably I have edited my efforts thoroughly to rid the wording of any thought which might convey rank idleness, declining powers, good-riddance, or mournful resignation. I borrowed the theme of rugged Liberty Hyde Bailey of Cornell instead, to carry the idea that this person was not laying aside his profession or his talents or his strength, but merely transferring them from routine grooves to a wider and broader line that previous experience and wisdom had fitted him to enter.

FOR background to that, you recall that Dr. Bailey's suggestion is that you are lucky to reach the time when you can leave a prescribed post with its limitations to really begin to be your own boss and seek the goals so long postponed—or something of that nature. It means that during a whole lifetime of specialized effort and study one crosses intriguing paths that lead off into attractive places. Yet, if you are a woodsman guiding a party direct to the nearest objective, it is treason to stop and chase off willy-nilly after strange calls, wafting scents, and distant vistas. No, you leave that fond pleasure for a time when you are alone and undisturbed by responsibility, when you can make a campfire on some wild promontory and gaze off at the clouds, the mountain mists, and the eagles in the sky. And you don't have to be crazy or erratic or neurotic to follow such a dream.

Now, as I noted before, all this romantic side of retirement is just so much bilgewater to anyone whose health is spent and who must quit his accustomed toil and breadwinning perforce unwillingly. Let us omit such persons from our present discourse, for their happiness rests on a degree of fortitude for which few have any recipe. (Save that of Christian courage.) And so, returning to my "work obituary," it is safer and better to include some hint therein that the subject of the sketch is still an active consultant, a pursuer of facts and studies, who is making good use of spare time to extend the scope of knowledge or good will, with no thought of idling or drifting to an inglorious exit.

THERE are also those who really quit the fields in which their life has been spent, to relax and refresh themselves with games, sports, social diversions within their strength, or trips to a far country. I have seen numbers of these elderly fellows seated in clubrooms around smoky card tables, or chalking cues, or lugging golf bags—tackling anything but tennis. Some of us who do not have a happy faculty for convivial hours or whose skill and liking for games and contests have never been strong find little relief or comfort in store if retirement means just "resting."

Strange enough, we who are not fortunate in this respect begin to wonder and worry lest our boon companions will avoid us because we do not care for hunting, sporting, or traveling. Yet this is just an idle fancy, because what things a man considers relaxing and enjoyable to himself are really the things he needs and must indulge in—regardless of what form the other guy's recreation takes. No matter how vast the volume of work a fellow has performed in his favorite field, the world always has dark corners left and unsolved points to wrestle with right within that science or that craft. If your own work is your main hobby, keep right at it.

Your own reputation and standing will usually justify it and see you through with satisfaction. For heaven's sake do not lay it down to learn poker or pool. Leave that to the chaps who need outside stimulus to keep mentally vivacious.

There's another class of men who come to retirement without enough substance saved to see them through. As in cases of those who are ill and failing, few of us are able to offer much but sympathy and perhaps some tem-

porary task to tide them through awhile. Here again we face a situation wholly beyond advice or ordinary remedy. It is here that the progress in remedial social legislation finds its most glorious fruit. The old, outmoded way—depending upon the children or the poorhouse on the hill—is a shameful reminder of an age of materialism.

So, then, for the most of us who are neither invalids nor paupers, there should be nothing upsetting in the act of quitting a certain group of rooms or set of people or time of beginning or ending a day's routine. To admit that we are stumped by customary scenery being taken away is to admit that we are not much more than machines and marionettes. We do not quit because we are sick. We do not quit because we are mentally failing. We do not fear to quit for lack of money. But we do quit because we are too old and too smart to stay on and miss the opportunity to be ourselves instead of being in somebody's way.

Yet I have a quarrel with some of the rules of the retirement system, wherein certain corporations and some government offices take an arbitrary digit and set that down as the end of any and all employment. I know several fellows who went on the retirement list in far better vigor and health than many of the men half their age who were retained under the rules in force. This can be dismissed with the thought that the employing agency may have been the loser.

Solace and happy reflection for mature workers who approach the time when they must quit what they are presently doing to enter a more purposeful and self-directed era have been the theme of philosophers for countless ages. Maybe a few quotes from ancient sentiments of this kind may not be wholly lost.

IN an old English Reader issued at Utica, N. Y., in 1832, there is a piece about "virtuous sensibility" and what it does to him who possesses it, when other things fail.

"The good effects of true sensibility on virtue and happiness admit of no dispute. . . . Even the face of nature yields a satisfaction to him which the insensible can never know. When he beholds the spring coming forth in its beauty and reviving the decayed face of nature, or in autumn sees the fields loaded with plenty and the year crowned with all its fruits, he lifts his affections with gratitude to the Great Father of all and rejoices in the world about him.

"His powers are much more frequently called forth into occupations of pleasing activity. Numberless occasions open to him of indulging his favorite taste, by conveying satisfaction to others. Often it is in his power to soothe the afflicted heart, to carry some consolation into the house of woe.

"In a circle of friends enjoying one another, he is as happy as the happiest. He lives in a different sort of world

(*Turn to page* 51)

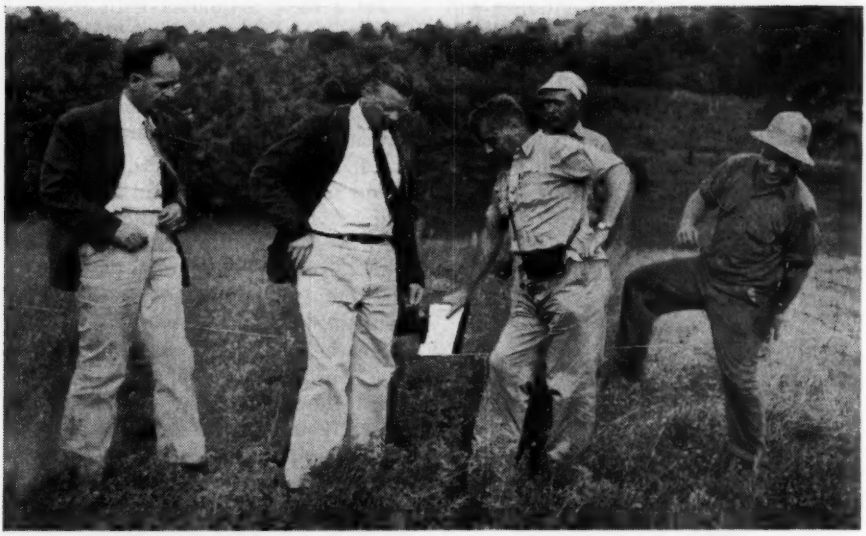

Fig. 1. The Reed Brothers, of Claremont, stood high in the Green Pastures program in New Hampshire. In the picture, from left to right, are Louis Zehner, New England Chairman; Stanley Colby, County Agent of Claremont; Ralph Littlefield, New Hampshire Extension Agronomist and Chairman of the New England judges; and the Reed brothers themselves. Note the heavy pasture growth in August, also the electric division fence which everyone regards with caution.

Things Learned from the 1949 N. E. Green Pastures Program

By Ford Prince

Agronomy Department, University of New Hampshire, Durham, New Hampshire

THE second New England Green Pastures program has now been completed. For a time during the summer of 1949 it appeared that the extreme drought would interfere with judging, if not suspend it altogether. In spite of this midsummer drought, which was the worst in the 75-year history of weather bureaus in the area, and summer temperatures that averaged four degrees above normal, judging went forward on schedule. Many excellent pasture programs were found and some observations were made which should be valuable in future years, whether wet or dry.

The regional judges who picked the three top pasture programs in each of the six New England States secured fairly complete data. These data present an accurate picture of the methods on each of these farms and not only furnish a clue as to why these farmers were up at the top of the heap in their respective states, but outline the forage pattern which is now so well defined amongst the progressive dairymen in the area.

Again, as in 1948, the soil-fertility programs of these men stand out as being more or less revolutionary when compared with the ideas of the fertility needs of forage crops in the immediate past. If these records mean anything, it is that to produce high yields of forage, lime and fertilizers must be skillfully used, and used in abundance.

State and regional judges have emphasized this point by saying that in the drought, those men who had kept their soils in a high state of fertility had made better pastures and hay crops than those whose use of fertilizers was more limited. From this point of view, then, we have learned something from the drought.

An analysis of the figures on these 18 farms shows that they had 2,471 acres of field land and 248 acres of improved permanent pasture, or a total of 2,719 acres which were being regularly limed, fertilized, and manured. They kept 1,102 cows and 407 young stock for a total of 1,306 animal units, or almost exactly an animal unit on each two acres of land. To do this, high fertility is certainly required.

During the year, these farmers used 1,430 tons of lime, which is just over a half ton for each acre of improved land and amounts to more than a ton of lime for each animal unit on the farms. Here, then, is the basis for a good fertility program, a liming procedure that has been going on on these particular farms not just this year alone, no doubt, but for many years.

In respect to the amount of fertilizer used, the data show that these 18 farmers purchased 815 tons of fertilizer during the year. This averages 600 pounds for each acre of land in feed crops and gives a total of 1,250 pounds for each animal unit on the farms. These amounts per acre and per animal unit are slightly higher than the figures indicated for the 1948 winners, but not significantly so. What they do emphasize, it seems to me, is that the new pattern for fertilizing forage crops is now at around 600 pounds per acre. Where it will go in the future can only be conjectured and will undoubtedly depend upon economic factors, the trend into irrigation in the area, as well as a continued trend into more intensive roughage programs.

Since these top men are relying very

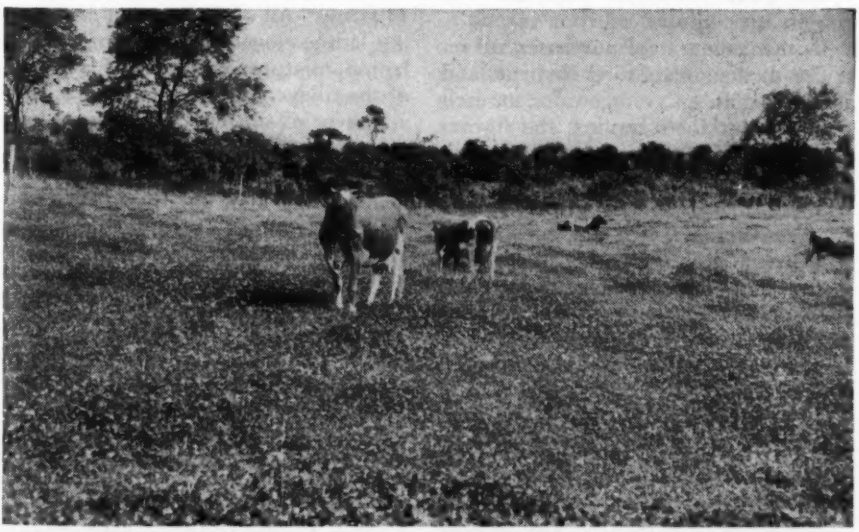

Fig. 2. The aim of the Green Pastures program is to stimulate the development of pastures like this one on Sumner Brown's farm, West Swanzey, New Hampshire. Five acres of ladino, with irrigation, fertilized lightly after each grazing, fed 27 head through most of the season of 1949.

heavily upon ladino clover and alfalfa in mixtures with grasses, we have been very much interested in the fertilizer grades and ratios which they have used. Fortunately, this year we have a complete record of all fertilizers purchased on these farms. Breaking these purchases down into the various grades and materials shows the following:

Materials	Superphosphate	287	Tons
"	Muriate of potash	46	"
"	Ammonium nitrate	2.5	"
Grades	0–14–14	185	Tons
"	5–10–10	96	"
"	3–12–12	72	"
"	8–16–16	38	"
	Miscellaneous [1]	88.5	"

It will be observed that this list of fertilizers does not include the manure produced on these dairy farms, although it does include 285 tons of poultry manure which was purchased or otherwise secured from nearby poultry growers. In evaluating this poultry manure, we have assumed that it carries in one ton an amount of plant food which is equal to one bag of 10-10-10 fertilizer. This, in view of recent poultry manure analyses, is a conservative figure.

If, then, these total purchases are reduced to their plant-food elements and if we calculate an average value for each ton of plant food applied, the figures show that this fertilizer would approximate a 2-14-10.5 grade for the whole lot. The phosphorus content of the average grade is higher than that for potash, it is true, but this is not surprising. Most of the superphosphate is distributed under the government programs and, at the moment, it is somewhat easier to get phosphates than potash. At the same time, the tendency is to balance the phosphates with potash pound for pound, even though actually it wasn't quite achieved. For balancing these two nutrients in the production of clovers and alfalfa there is ample proof.

Furthermore, if we carry the plant food applied one step further and add to it the cow manure which was used on these farms, it is apparent that these farmers are applying actually as much potash as phosphates, since cow manure is higher in potash than it is in phosphoric acid. To make this computation, I have assumed that each animal unit produces eight tons of manure annually, which is saved and returned to the land. Using the average value usually ascribed to farm manure of this kind as containing 10 pounds of nitrogen, 5 of phosphoric acid, and 10 of potash, (although I realize that these values may be slightly shopworn) and adding these figures to the plant food purchased, we arrive at a fertilizer which is almost exactly in a 1:2:2 ratio, or one which approximates a 5-10-10 or an 8-16-16 fertilizer.*

The fundamental reason for the dependence of these farmers upon fertilizers high in potash and phosphoric acid is revealed by their cropping systems. Ladino clover, of course, stands out as their major pasture clover, with alfalfa a prominent crop on 10 of the 18 farms. All of these men were growing ladino clover. In point of acreage, ladino mixtures occupied 55 per cent of the tillage land on these farms, with alfalfa or alfalfa and ladino mixed occupying another 20 per cent of the acreage. This means simply that three acres out of four on these top farms were in legumes or legume mixtures, and, of course, legumes are heavy users of potash and phosphorus, as well as lime.

This drought year has been a good one to test farmers in producing feed and to test the efficiency of crops under extremely dry conditions. Frankly, it has not been a good ladino clover year. Alfalfa has shown up to much better

(*Turn to page* 50)

[1] Miscellaneous grades include: 7-7-7, 10-10-10, 5-12-20, 5-12-8, 4-12-4, 6-9-12, 3-12-6, and poultry manure brought onto the farms from nearby poultrymen.

* Note: According to these calculations the actual amount of plant-food elements applied on these farms was nitrogen 134,000 lbs., phosphoric acid 282,000 lbs., potash 275,000 lbs.

Irrigation Opportunities in the Southeast*

By W. B. Camp

W. B. Camp & Sons, Inc., Bakersfield, California

IRRIGATION is used so little in the Southeastern States, with their supposedly ample rainfall, that in advocating it one runs the risk of being labeled "fantastic" even though irrigation could lead to better farming in many areas. I am perfectly willing to run that risk, or to advocate any other agricultural change or development that will enable Southeastern farmers to produce "a quantity of quality product on the same acre."

Good farmers everywhere are continuously trying to reduce production costs by growing bigger and better crops. Farming is the most competitive business in the world. Successful farmers are those who can do the production job both better and cheaper. They know—just as surely as water runs downhill—that the consumer's dollar is eventually going to the farmer who can grow both quality and quantity and do it economically.

Irrigation Has Limitations

Irrigation, of course, has its limitations. I certainly am not advocating for the Southeast any blanket use of irrigation. As a matter of fact, the greater percentage of Southeastern land probably should not now, or ever, be considered for irrigation. Certainly not every acre on every farm in the Southeast could possibly be considered for irrigation.

On the other hand, irrigation also has its possibilities and its opportunities, and I submit that these are worthy of greater exploration and greater study. This is particularly true where farms or fields are adjacent to or near a free water supply such as a river, creek, lake, or inexpensively constructed pond.

Agricultural progress is built on the overcoming of obstacles. Our forefathers cleared the forests. Since then, succeeding generations have labored to keep the soil fertile, to develop better production methods, and to lower unit costs.

In this battle to obtain "a quantity of quality product from the same acre," agriculture has had the invaluable help of science and the technical skills. As a result, most good farmers know—whether they actually practice them or not—such basic things as how to take care of their soil and the other essentials to crop growth and maximum yields. I believe that these same good farmers who have been quick to adopt new developments once they had been proven are the very ones who will eventually look on irrigation as a tool of production that will give them increased yields and higher-grade crops.

I was born and raised on a South Carolina farm. My education was obtained in South Carolina schools. Since I finished Clemson, some years ago, most of my farming has been and still is in California. However, at the present time, my two sons and I are developing some cattle properties in the Piedmont section of South Carolina.

* From an address by W. B. Camp, W. B. Camp & Sons, Inc., Bakersfield, Calif., before the Association of Southern Agricultural Workers, Baton Rouge, La., February 1, 1949.

Out there in California, where I am, we live by irrigation. Without it we wouldn't farm, we could not farm, except possibly a little ranching on those dry lands. In this respect, the Southeast has a wonderful advantage over the West. Out there we have to raise all, or nearly all, of our crops with irrigation water. The Southeast would need only to supplement its rainfall, which is not often very deficient.

Crop Insurance

To the Southeastern farmer who can obtain irrigation economically, this man-made rain could undoubtedly be the finest "insurance" he could secure for his crops. Just as the average good farmer, as a matter of good business, carries fire insurance on his barn, many Southeastern farmers could insure "a quantity of quality product from the same acre." But, just as the farmer has to obtain and carry that fire insurance so it will be there ready to help him in case his barn burns, he ought to have his irrigation equipment in and ready so it can prove its value in times of drought.

Sometimes the application of a small quantity of water makes the difference between an abundant crop and a partial or total failure. I am sure that those of you with farm background can recall the terrible experience of watching a growing crop literally burn up in the field while waiting for rain. How wonderful it would have been to have been able to control the moisture on those crops, to have been able to apply life-giving water at the proper time, to have saved the tremendous economic loss and resulting heartaches in the farm home.

I can recall at home in Cherokee county, South Carolina, that we seldom if ever made a crop that did not suffer at some time during its growth from lack of moisture. In an area with about a 47-inch rainfall, its hard for the dryland farmer to see the need for irrigation here. But it does exist, for these Southeastern lands do not seem to hold water like the lands in the West do. There, a watering will often last for weeks. Here, a shower is largely gone in a week or two at most.

Weather records for the past 42 years at the Columbia, South Carolina, Station show the following number of drought periods during that time: 117 periods have run from 14 to 21 days; 79 periods have run 21 to 27 days; and 69 periods have run over 27 days without rain.

Thus we see that during the past 42 years we have had a total of 265 drought periods that were sufficiently protracted to seriously damage a crop or entirely blast the harvest, if it hit at the critical time. The record at Columbia is doubtless representative of the entire Southeast. That's a little over six drought periods a year. Weigh that against crop yields.

In most of the irrigated areas of the country, getting suitable water for irrigation is the problem. In the Bakersfield, California, area where I live, the water comes from deep wells and has to be pumped. One well will take care of about 160 acres, roughly, and it costs $10,000 to $25,000 to drill and completely equip with pumping plant. The land has to be leveled and periodically planed. So you can see that all of this adds enormously to the capitalization of farming there. The same holds true where water comes by gravity from the large irrigation basins that have to be paid for.

Nature Favors Southeast

It's obvious that the Southeast is favored in this respect. It is one of the best watered areas in the country. The mountain areas, where most of the streams originate, have heavy waterfalls. In fact, a considerable strip of the Southern Blue Ridge mountains shows a rainfall in excess of 72 inches. Only one spot in the Nation equals that, and it is a small area in the Northwest.

The Southeast has a dependable water supply, whereas irrigation wells vary and sometimes become pumped

out. Streams vary and threaten the great irrigation areas at times, and there is a fight for water rights in the old, dry irrigation areas. But here in the Southeast the ancient streams go to waste down their channels to the sea, as they have done for ages, while crops often wither and perish on their very banks.

With costs mounting on every item that goes into a crop, we will be foolish if we do not look into every means of lowering costs and increasing yields. The know-how is at hand for making big yields of all crops. Improved varieties, cultural methods, and the like make this so. We can usually control insects and most other hazards and make good yields, if we get the water. With modern irrigation systems that do not require leveling of the land, and with good fresh water going to waste by many a field in the Southeast, I am wondering if this area will be long in finding out more about the possibilities of the man-made shower to insure the harvest here.

Irrigation in South Carolina

Something is being done toward exploring the possibilities of practical irrigation in South Carolina. Some of the other Southeastern States are making similar moves. South Carolina has an Extension Engineer available to help farmers plan and develop irrigation. And I am told that farm calls are now keeping him busy. The Experiment Station has started experiments in irrigating crops on rolling lands. Encouraging reports come from those farmers who are getting irrigation started on their farms.

In York county, Mr. Cloinger got seven good cuttings on his irrigated alfalfa during 1948's dry summer while other plantings in that area yielded but three to four meager cuttings because of lack of moisture. He irrigated from his farm pond and is building another in order to have more storage for water.

In Greenville county, the high yield of corn for 1948 was made on irrigated land. There were other fields that had just as good a chance, except this one had the needed shower applied through irrigation at the right time. It made 162.24 bushels of dry corn per acre, as determined by Clemson College, while the other similar fields made from 80 to 100 bushels. There were enough stalks and fertilizer for them to have made more, but there was not enough water.

Normal Rainfall

Experience indicates that normal rainfall can't usually be counted upon to make more than 80 to 110 bushels of corn per acre, and it takes a pretty favorable season to do that. But, according to this Greenville experience, the added water can push that up by something like 50 per cent in a fairly good corn year. If it had been a bad dry year, as often comes in that section, the benefit from this irrigation would likely have been even larger. That water came from the creek that was flowing to waste along its ancient channel by the field, as it had done for ages, until the farmer put some of it to work for the first time.

In 1946 the cantaloupe crop in the Blackville area was ruined by drought in May. One man reached part of his field with irrigation. From that, he sold $253 worth of cantaloupes per acre. From the rest of the field, none.

At Clemson last fall, Dr. Garrison produced a bumper crop of late tomatoes with irrigation when it was so dry that others were of little value. He saved them twice from frost by turning the water on before day and washing the frost off before the sun struck them. This extended the season several weeks and added greatly to the yield.

In Chester county, Porter Gaston kept his pastures lush and green during the summer while others around him became parched. "Skeet" Allison of Richland county did the same thing with sprinkler irrigation from a stream that flows by his pasture.

In Greenville county, Earl Taylor saved his early peach crop from the

May drought by irrigation. His irrigation worked well on his fall tomatoes, too. He is putting in more ponds for more water storage. Dave White, at McBee, has pioneered with irrigation on his sandhill peaches, having to pump the water over a mile and raise it over 100 feet. But it has given him some of the finest peach crops in the State, despite dry years. He has practically no small peaches or culls, while other orchards there are making mostly marbles due to drought.

Several large truckers along the coast have been irrigating for some years. They say now, after these years of experience with it, that they would not try to farm a piece of land that couldn't be reached with the showers that they control.

These examples are from my native State of South Carolina. Other Southeastern States have similar case histories.

In Other States

The North Carolina Extension Service is promoting the widespread use of farm fish ponds. In many instances irrigation is going hand-in-hand with the ponds. Truck farmers in eastern North Carolina for some years have found irrigation profitable. On some of the mountain farms surface irrigation is widely used, with water being drawn around the hills in open ditches. Experimental irrigation on tobacco fields is going on in Wake and Halifax counties. Guilford county farmers are using irrigation on their pastures, and general farmers in Rowan county have been irrigating for years.

In Georgia, the number of irrigation systems has increased five times since 1945. Nearly 5,000 acres of all types of crops are now under irrigation, and the Georgia Extension Service estimates that this acreage will be increased considerably in the near future. Georgia dairy farmers who have found they can double their winter pasture grazing are among the most enthusiastic boosters of irrigation.

The Florida Extension Service reports that irrigation is rather widely used in Florida now for both citrus fruits and truck crops. Sub-irrigation, surface, and overhead irrigation are used on truck crops. As irrigation proves its value on truck and citrus, it no doubt will become widespread in Florida.

In Mississippi, the State Extension Service reports that its engineers are observing several irrigation installations. The State has between 50 and 100 acres of truck crops being grown experimentally under irrigation. Results so far have been so satisfactory that commercial truck crop growers are being advised to put in irrigation facilities, especially for growing fall crops for market.

In Louisiana and Arkansas, large-scale irrigation for rice is a "must" and has been routine in that area for a long time. In the Louisiana strawberry belt, many small farms are irrigated with individually operated systems using shallow wells. Most berry farmers have similarly simple systems and in many years would be unable to grow plants without irrigation.

The Louisiana Extension Service reports that during the past year 14 vegetable growers between Baton Rouge and New Orleans have installed pumps to draw water from the Mississippi river. There are other systems used by vegetable growers below New Orleans. Louisiana gets ample moisture, but often at the wrong time of the year. The vegetable growers get most of their dry weather during the fall, and not infrequently find their irrigation systems useful in the spring as well. On experimental sweet potato plots, Louisiana has found, in some years, that irrigation has increased production by 50 to 100 bushels to the acre.

It's not geographically in the Southeast, but we all like to claim Texas as a "Southern" State, so I don't believe the folks in the biggest State of all would mind my using some of their irrigation figures.

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BARLEY RESPONDS TO POTASH

Fig. 1. Barley yield was increased by 10 bushels per acre where 0-20-20 was applied as compared to 0-20-0 on the farm of Douglas Goodrich, St. Croix county, Wisconsin. Both fertilizers were applied with a combination fertilizer-grain drill at the rate of 200 pounds per acre.

Why the Push on Potash

By C. J. Chapman

Soils Department, University of Wisconsin, Madison, Wisconsin

POTASSIUM (commonly referred to as potash) is an essential element of plant food. In fact, it is one of the so-called "critical" elements. More and more, soils in Wisconsin are becoming deficient in their supplies of available potassium.

The lack of potash reflects itself in the stunted growth of many crops and their inability to produce vigorous, healthy leaf growth. Potassium is in some way related to the synthesis or formation of starches, sugars, and cellulose or fiber. Sugar beets, potatoes, cabbage, hemp, tobacco, and onions—in fact all of the bulb and root crops as well as fiber crops—are heavy feeders on potash. Corn and all members of the legume family, such as alfalfa and clover, are likewise very heavy feeders on potash.

The percentage of potash in mixed fertilizers is always that amount expressed in the third figure of the formula. Thus, a 4-12-8 fertilizer grade contains 4% of nitrogen, 12% of phosphate (P_2O_5), and 8% of potash (K_2O). When we speak of potash we are actually referring to the element potassium. The chemists in early days got into the habit of calling the oxide of potassium *potash*. The word *potash*, then, is usually used when speaking of the salts or oxides of potassium, whereas the word *potassium* is used when we refer to the element itself.

Theoretically, there is enough total potassium in our soils to meet the requirements of our crops for a good 200 years. But it is not becoming available fast enough to satisfy the requirements of even average-yielding crops. In other words, much of the potash in our soils is a "frozen asset." Actually, we have been using up this diminishing supply of potash as fast as it becomes available from the native stores of potassium-bearing minerals in the soil. Hence the need for supplemental applications of potash fertilizer in order to make possible the production of good yields of farm crops.

Soil Tests and Field Demonstrations Reveal the Lack of Potash

Twenty-five years ago soil tests indicated that phosphate was the chief limiting element of plant food. Next in line was potassium. In those days a good 75% of our soils showed a deficiency of available phosphorus, but only 50 to 60% of these soil samples were deficient in available potassium. Now, however, tests show that supplies of available potassium are relatively lower than those of available phosphorus. Tests made on 166,464 soil samples during the past five years showed 71% deficient in available phosphorus, whereas 79% were deficient in available potassium.

Field demonstrations with fertilizer support the findings of our soil tests. The average of 735 grain demonstrations carried out over a period of the past 16 years gave increases of 10½ bushels where straight superphosphate (0-20-0) was applied. Where potash (0-20-20) was added, yields were increased by 17 bushels. But that is only part of the story, for the residual benefit of fertilizer applied at the time of seeding resulted in substantial increases in the yield of clover and alfalfa the following year, and here potash has played an even more important role. The 0-20-0 plots made an average increase of 1,340 pounds in yield of legume hay; on the 0-20-20 plots there was an average increase of 2,101 pounds of hay.

One reason for the diminishing supply of available potassium in the soils in Wisconsin is the fact that we have wasted tremendous amounts of it in the careless handling of stable manure. We have been shortchanging our cropland in the plant food returned in manure applications. When we realize that from 70 to 80% of the potash contained in crops fed to animals is voided in the liquid manure, we can readily appreciate the reason for the diminishing supplies of this valuable plant food. More and more, farmers are becoming aware of this fact and are doing everything possible to prevent losses of this liquid portion.

Wisconsin livestock farms are losing potash at a more rapid rate than are the farms in the corn, soybean, and grain-growing states, where most of the residues of these crops go back on the land. Most of the potash taken up by a crop of grain is in the straw, and where combined, the straw is usually left on the field to be plowed under. The same is true for soybeans. Where corn is husked in the field, the cornstalks are left on the land, and when plowed under, return potash and organic matter to the soil. However, where crops such as alfalfa and clover and corn are harvested and fed to our livestock, there may be, as pointed out, a considerable loss of potash in the handling of animal manures. Authorities tell us that on the average farm not more than 45% of the potash contained in crops fed to livestock actually finds its way back to our fields in the manure.

The great increase in the acreage of alfalfa on farms in Wisconsin in recent years has resulted in pumping potash out of our land at an accelerated rate, and this is in part responsible for the rapid decline in the supply of available potassium in our soils. In fact, it is my belief that in recent years the lack of potash in Wisconsin soils has been more responsible for short crops of alfalfa and clover than has the lack of phosphorus.

In the early days, wood ashes were an important source of potash. We read in early American history where trees were cut and burned for their ashes, these ashes leached, the potash extracted, and this potash shipped to Europe.

Prior to World War I, the potash used in America came from the German mines. Since then potash has been extracted from the brines of certain salt lakes of California and Utah; in fact, one of our largest potash refining companies is located at Trona, California, where the brine of an old lake bed is the source of thousands and thousands of tons of potash fertilizer every year. Beginning in 1931, the large deposits near Carlsbad, New Mexico, have furnished even larger amounts of potash for agriculture and industry.

Speaking of wood ashes, most farmers have observed that where brush piles were burned in the field, clover and alfalfa grow luxuriantly. Wood ashes carry from 3% to as high as 8% of potash. Of course wood ashes contain from 60 to 70% of lime and some phosphate as well. Nevertheless, it is the high potash content of these wood ashes that makes them so valuable as a fertilizer for legume crops.

Also observed has been the fact that an abundance of potash in our soils results in stiffer straw in our grain crops. The stubble of grain in those spots in fields where brush piles were burned literally bristles, and new seedings of clover are frequently found to be knee-high in the fall of the same year in these spots, whereas the seedings in the rest of the field may be just a bare "catch."

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LEGUMES RESPOND TO TREATMENT WITH POTASH

Fig. 2. The response to treatment with potash may not always show up on the grain (nurse crop) the year seedings of clover or alfalfa are made, but the residual effect of potash in the mixture will frequently make a big showing the year following. This was true on Christ Mayer's farm, Junction City, Wisconsin. The soil was Spencer silt loam.

Yields of Oats

0-20-0 @ 400 pounds per acre	51.0 bushels per acre
0-20-20 @ 400 " " "	48.2 " " "
No fertilizer	29.2 " " "

Yield of Clover-Timothy Hay the Following Year

0-20-0 (applied previous year)	2,623 pounds per acre
0-20-20 (" " ")	5,997 " " "
No fertilizer	469 " " "

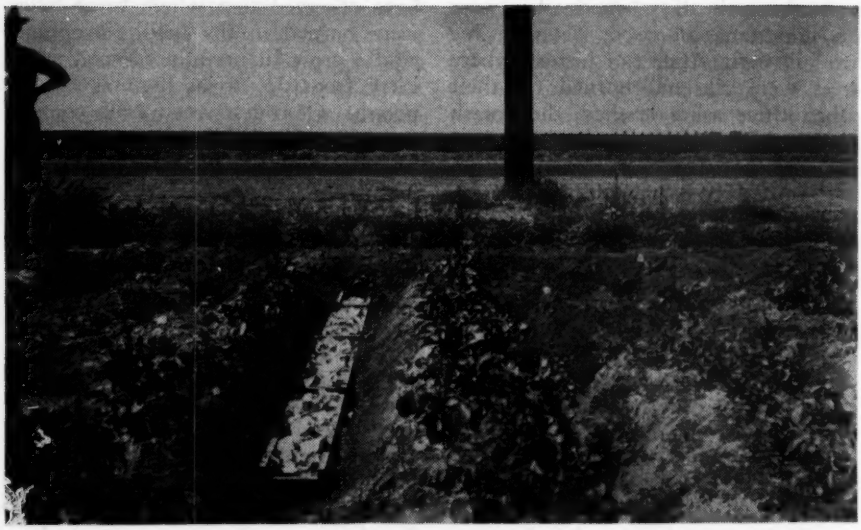

Fig. 1. Experimental method of dissolving gypsum in irrigation water for individual tests in Kern county, California.

The Use of Gypsum In Irrigation Water

By J. D. Axtell[1] *& L. D. Doneen*[2]

WATER penetration of soil has, in recent years, become a problem in certain areas of the upper San Joaquin Valley of California. It is also known that certain types of irrigation water may be harmful eventually to plant growth.

One of these types constitutes an unfavorable sodium-calcium ratio which may cause a sealing of the surface soil, preventing the water from penetrating into the lower root zone. This dry condition results in wilting of the plants between irrigations. Even if wilting is prevented by frequent irrigations, the growth of the plant is somewhat retarded due to the limited volume of wet soil from which plant nutrients may be absorbed.

Well water, or underground water, contains minerals in varying proportions, depending upon the type of material through which the water percolates. If the minerals dissolved are in the form of calcium and magnesium salts, the water is known as hard water, and common soaps do not form suds

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in it readily. This type of water usually is considered good for irrigation purposes, as only occasionally do the calcium and magnesium salts reach a concentration toxic to plant growth.

On the other hand, the so-called soft water may come from either of two sources: (1) rain water that contains very few minerals, which usually will include runoff waters from melting snow or excessive rains which have not had sufficient contact with soil or rock to dissolve appreciable quantities of minerals; and (2) water containing a high percentage of sodium salts. These salts may reach a concentration toxic to plants, but even at low concentrations they cause deterioration of the soil structure. With their continued use, the surfaces of the soil will seal and prevent the wetting of deeper layers. To counteract this condition, gypsum is applied to the land, and in some localities it is a general practice to apply 1 to 15 tons per acre.

Irrigation Waters Studied

A study was made with irrigation waters of low salt content, but with most of the salts in the form of sodium (90-92 per cent sodium), in an area of extremely low infiltration rates. In other words, the rate of water intake by the soil was very slow. Even with furrows one-half mile long, and small flows, a large percentage of the irrigation water was run off at the lower end of the field.

A large number of infiltration tests were made under these conditions. Varying quantities of gypsum were continuously dissolved in the irrigation water. Upon adding the gypsum, the irrigation showed only a small increase, but continued to increase with succeeding irrigations, and gave an over-all increase of 40 to 168 per cent when compared with the untreated irrigation water.

The results of some of these tests are given in Table I.

In fields "A" and 123, the irrigation furrows were one-fourth mile long; in the others, one-half mile. The infiltration rate is given in gallons per minute for the entire length of the furrow for the untreated water, and for the furrows irrigated with water containing dissolved gypsum. The last column of Table I gives the per cent increased infiltration from the use of gypsum. Of the total salts, 90 to 92 per cent is in the form of sodium salts. After adding gypsum (calcium sulphate $CaSO_4 \cdot 2H_2O$), the per cent sodium was reduced in proportion to the quantity dissolved. The amount of reduction is indicated in the fifth column of Table I. Analyses of the waters numbered "A" and 122 have approximately the same percentage sodium in relation to the other minerals, but water "A" has nearly twice the quantity of sodium as has water No. 122. Therefore, it will require about twice the quantity of gypsum to reduce the per cent sodium to a given level in water "A" as compared to water No. 122. The pounds of gypsum added per acre-foot of water are given in the fourth column of Table I. These tests were made over periods of three weeks to more than two months. During this time, gypsum

Fig. 2. Gypsum applicator designed by University of California, Agricultural Extension Service, Kern county, California.

was continuously added to the water which was used in irrigating the gypsum furrows. A number of tests were made on these furrows and are listed as No. of Tests in the second column of Table I.

After adding the gypsum, the first irrigation showed only a small increase, but continued to increase with succeeding irrigations until it was greater than that reported in Table I. The percentages reported in the table are the average of all the tests, including the low percentages at the beginning of the experiment and the higher ones later in the trial. The soil is classified as Delano sandy loam for the first three fields listed in Table I, that is, fields No. "A", 124, and 126. The reduction of sodium to 60-70 per cent in these fields gave a 65 to 70 per cent increase in water penetration, with a smaller reduction in sodium (75 to 77 per cent) an increase in water penetration of 33 to 40 per cent was secured for fields 126 and 124. Field No. 122, with a soil classified as Hesperia sandy loam, gave the greatest increase in infiltration with the use of gypsum. The third soil type reported in Table I is Field No. 123, classified as a Madera sandy loam and a hard-pan soil. Thus, soil type plays a role in water penetration, particularly in the rapidity with which a high sodium water will seal a soil and prevent rapid infiltration.

Direct application to the soil should be beneficial for the first few irrigations early in the season. While being effective in increasing penetration of water, the gypsum will be dissolved and leached from the bottom and sides of the furrows. After dissolving and

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TABLE I. INFILTRATION RATES OF WELL WATER BEFORE AND AFTER THE ADDITION OF GYPSUM

Field* No.	No. Tests Made	Treatment	Amt. of Gypsum added Lbs. per acre-ft.	Per Cent Sodium	Infiltration	
					Gals. per Minute	Per Cent Increase
A	10	Check	0	92	2.59	65
		Treated	660	57	4.26	
124	17	Check	0	91	4.58	70
		Treated	365	67	7.79	
124	11	Check	0	91	7.59	40
		Treated	191	77	10.63	
126	5	Check	0	92	5.55	33
		Treated	187	75	7.36	
122	19	Check	0	90	3.76	
		Treated	297	60	10.08	168
123	4	Check	0	92	2.66	83
		Treated	572	50	4.87	
Per cent increase due to gypsum (weighted average)						90.4

* For the purpose of this discussion, the waters used on these fields will be considered as having the same number as the field.

Some Fundamental Principles of Soil Building

By S. D. Gray

Washington, D. C.

AGRICULTURE in the Northeastern States, the oldest farming area in the Nation, started with vast soil fertility resources. These resources are still vast, but they have suffered tremendous reductions since the soils were cleared of forests. Continuous removal of plant food in the crops grown and the losses from leaching and erosion have seriously impaired their productive capacity. Cheap land, however, enabled many pioneer farmers to move to new areas when crop yields became unsatisfactory. Land abandonment, the inevitable result of this chop, crop, and get-out system of farming, was indelibly written in the agricultural record of practically every state in this region.

Northeastern agriculture, not unlike that of other great agricultural regions, has experienced prosperity based on soil fertility exploitation as well as the ills which inevitably result. Today everyone interested in the business of farming recognizes as the most important problem the application of a rational land-use policy—one that contemplates soil conservation as well as soil building. In any permanently successful land-use policy, the role of commercial fertilizer occupies a position of importance.

Early Colonial Practices

The earliest record of the need for plant food in this country dates back to the first white settlers. The Indians taught the settlers agricultural practices which, in the light of later scientific research, were sound and practical. Of greatest interest, perhaps, was their practice of using fish and wood ashes in the growing of corn. Fish alone, on the newly cleared land greatly increased the yield of corn, the Indians advised. On the older clearings, however, best yields were obtained only if a generous supply of wood ashes was used to supplement fish. Thus, it is evident that the essential plant-food elements, nitrogen and phosphorus supplied in fish, and potash and lime supplied in wood ashes, have played an important role since the beginning of agriculture in this region.

Research of Experiment Stations

Probably the greatest single factor in developing an appreciation of the need for conservation of our national soil fertility resources and the importance of commercial plant foods has been the system of State Agricultural Experiment Stations. Since their establishment under the Hatch Act of 1887 they have carried on a vast amount of research with soils, fertilizers and cropping systems, diseases and insects. The results of their experiments have been carried to the farmers by the Extension Services and have been the basis for soil management programs that have gone a long way toward the establishment of a permanent and prosperous agriculture. Supplementing these agencies is the Soil Conservation Service. Together these three hold the key to the prosperity of American agriculture.

Food consumption in the United States has increased enormously in the past decade. On the average each per-

son eats 1,650 pounds of food in a year or approximately 17 per cent more than before World War II. With a population of 145,000,000, the acreage of harvested crops in this country last year was 350,000,000 or about 2½ acres per capita. Census figures reveal that the population has increased 13,000,000 since 1940. At this rate it will likely approach 160,000,000 by 1970. The world population, now about 2¼ billion, has available for food production slightly less than one acre of farm land per capita. This disparity, between world population which continues to increase and land for food production the acreage of which continues to decline, poses a serious problem. The world problem of feeding an increasing population is not so much a matter of productive soils as it is of developing social institutions to put and keep our soils in full production. Unless we stop the losses and start rebuilding our soil, we cannot hope to maintain our present standard of living.

The big problem before farmers, wherever they may be located, is—How can we utilize to best advantage the remaining plant-food resources by such methods as will prevent further needless waste and, at the same time, increase the production of food without proportionate increase in cost? The problem is the same whether we look at it in terms of our own farms or the whole agricultural area of the Nation.

How Soils Are Formed

What is this thing we call Soil? It differs from most of Nature's creations in that it was developed from the outside in or from the top down. The fine material which went into soil came from rotting or mechanical disintegration of rock material near the surface of the earth. This process liberated soluble nutrients which were used by plants and was always accompanied by an increase in vegetative growth which was deposited on or near the surface to decompose. The rotting vegetative material supplied organic matter and considerable of the soluble plant nutrients. Over the ages inert rock material under the influence of plant and microbiological action became the soil, the source of all food—the foundation of civilization.

Virgin Soil Usually Fertile

Most virgin soils are inherently fertile soils. Their mineral, organic, and biological conditions have been kept in balance by natural processes. When man plows or cultivates a soil, however, he immediately brings about more favorable conditions for soil microorganisms (bacteria and fungi), which increase their activity. This stimulated activity increases decomposition and finally reduces the organic-matter content of the soil. Incorporation of organic materials into the soil by plowing is not conducive to its unlimited accumulation. This does not mean that the turning under of organic material is an undesirable practice. It merely indicates a weakness in our soil management programs and emphasizes the constant need for consideration of cropping systems and cultural practices designed to maintain optimum organic content. An important value of cover crops or green manure crops, it should be pointed out, is to convert the soluble plant nutrients of the soil into green material at a time when otherwise they would be subject to leaching and therefore lost.

Almost every farmer has observed that when land lies idle for several years, crops following the plowing of such land are better. This is attributed to the rapid decomposition and release of plant nutrients contained in the surface accumulations. Here, as in virgin soils, are natural soil-building processes in full action, working from the surface downward. Early observations on the benefits from incorporation of organic matter, as well as results of experimental work, no doubt influenced the development and use of the plow in soil management. The plow is necessary, of course, to get rid of plants and crop residues on the surface

and to make possible the preparation of a seedbed. Necessary and desirable as is the plowing operation, it is without question the chief reason why the organic content of our soils cannot be maintained satisfactorily and easily.

This discussion is not intended to infer that we must abandon the plow, for this cannot be done. It does, however, point to the desirability of redesigning the plow and other machinery for soil cultivation with the idea of effecting satisfactory seedbed preparation and soil cultivation without complete incorporation of plant residues. In other words, the ideal tool would be one that insures a proper balance between rapidly decomposing plant residues in the lower soil area and the more slowly decomposing plant residues in the upper soil area or on the surface. Recent research by agricultural engineers has partially accomplished these objectives in the designing of the T.N.T. plow. Its development marks the beginning of a new era in soil building through application of the fundamental principles in which Nature excels and from whom we still have much to learn.

Important Soil Factors

Figure 1 portrays the fundamental factors involved in soil building. While all five factors are important in crop production, the fact remains that organic matter always plays a central role. It is directly related to each of the remaining factors—moisture, aeration, soil temperature, and mineral nutrients. Unless maintained at an optimum level, the other factors are thrown out of balance and the soil's productive capacity quickly deteriorates.

Much ado is being made today about the great importance of organic matter in relation to soil fertility, soil conservation, and crops of satisfactory nutritive value. This is as it should be. Soil organic matter is of tremendous importance. No one questions that. It serves as a food for various types of desirable soil microorganisms. It supplies essential plant nutrients for re-use by succeeding crop plants. It aids in improving the physical qualities of soils. Its presence as living or dead material on or in the soil aids enormously in the control of erosion by wind and water.

The fertility and organic-matter content of gardens and other small areas may be satisfactorily maintained through the use of animal manures and composts. However, when larger areas are involved, as is the case in general farming, this practice becomes impracticable because of the enormous volumes which would be needed and the labor cost involved. Fortunately, in general farming, it is both convenient and profitable to follow a crop rotation system to supply organic matter and to use animal manures produced on the farm in the feeding of crops. About all that is required is proper use of lime, phosphorus, potash, and some-

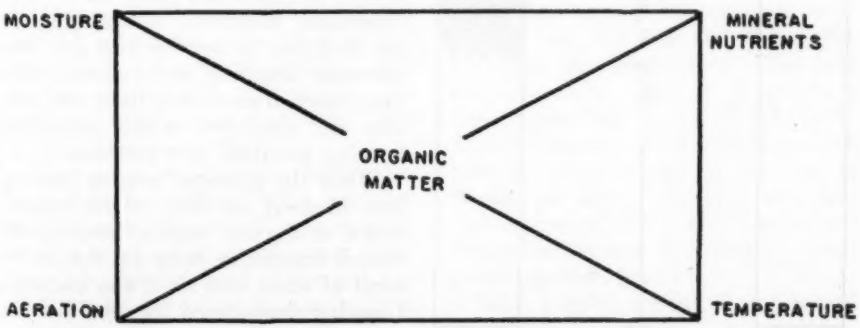

Fig. 1. Important soil factors

times nitrogen. Thus, the key to the nitrogen and organic matter problem is a high mineral fertility which will assure a luxuriant growth of the superior legumes, such as alfalfa and the clovers, particularly, sweet clover.

Give The Soil Air

Agronomists tell us that soils need more air than they are getting under American methods of farming. This applies not only to the topsoil where the roots of plants grow heaviest and where they get the bulk of their food but also to the subsoil where they send their deeper roots. It has been shown by experimental work that if both the topsoil and subsoil were better drained and given more air, crops would grow better and there would be bigger cash return from the same acreage. In other words, if organic matter or humus can be injected into the soil, thus improving its physical condition, making it more porous and open, it rapidly becomes more productive.

If the topsoil and subsoil are dense and hard, neither soil air nor water with absorbed oxygen have that freedom of movement so necessary to plant growth. The principal reason for breaking up hard formations in our soil is to permit water to enter easily and quickly so that the plant roots will be able to get ample water during dry weather. When rain falls upon land, it passes downward through the air spaces until it finds an obstruction which causes it to accumulate or until it assumes the form of capillary water. If the soil structure is loose and open all the way down, there will be adequate water for plant growth and best performance of the soil microorganisms.

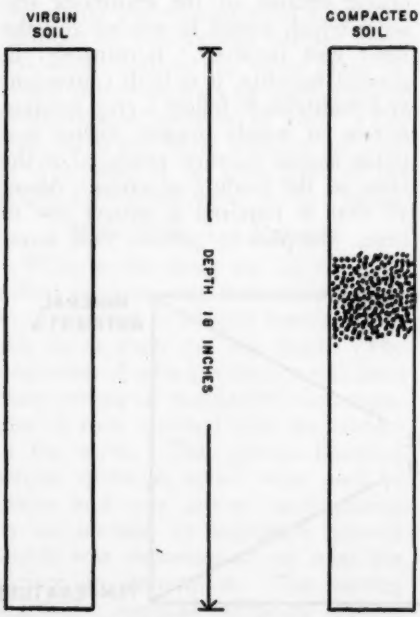

Fig. 2. Virgin soil versus compacted soil

Compacted Soils Versus Virgin Soils

If the topsoil is dense and compacted, the farmer generally knows how to take care of the situation. Ordinarily, he will make a generous application of manure, green or barnyard, and plow under all crop residues. Such operations as these tend to make the soil more porous and pliable. While the topsoil is an open book to the farmer, the subsoil often is a region of darkness and mystery. It is this part of the land being farmed that requires more and more attention on the part of the farm operator. Everything that he does in the way of machine operation, especially where heavy farm machinery is used, tends to compact the soil and to exclude air which is so necessary for the germination of seed and for the beneficial soil organisms which convert organic residues into plant food. It is important, therefore, in thinking of soil building to develop and put into operation cropping and cultural practices aimed at correcting those unfavorable soil conditions which prevailing farming practices have produced.

While the principal step in keeping land in good condition is the maintenance of organic matter, keeping the subsoil reasonably open for the movement of water and air is also essential. Growing deep-rooted legumes is com-

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Fig. 1. Pictured here is a field of alfalfa at the University of Georgia, College of Agriculture, Athens, Georgia, prior to the second cutting in 1949 and the 27th cutting of the field since it was established in 1942.

Alfalfa as a Money Crop in the South

By W. O. Collins

Agronomy Department, University of Georgia, Athens, Georgia

ALFALFA can be grown successfully and economically in the South. Field experiments established in 1942 on the agronomy farm of the University of Georgia at Athens, have shown conclusively that alfalfa can compete with cotton and other cash crops grown in the South.

The soil on which this experiment is located is classified as Cecil sandy loam and for approximately 75 years was cultivated by cotton-growing tenant farmers. The fertility level of the soil was probably below that of the average farm soil in the Piedmont Plateau Province.

In the spring of 1942 the land was plowed, harrowed, and sowed to cowpeas. In August the cowpeas were plowed into the soil and thoroughly cut with the disk-harrow. The land was harrowed with a drag-harrow about September 15, and on October 15 Kansas common alfalfa seed were sown with a cyclone seeder at the rate of 50 lbs. per acre. The land was then cross-harrowed with a drag-harrow, and cultipacked in two directions to insure a firm seedbed.

Table I shows the initial and annual fertilization. For the first two years

muriate of potash was applied at the rate of 200 lbs. per acre. Potash was increased to 300 lbs. per acre in 1946 and in 1947, then raised to 400 lbs. per acre in 1948. Nitrate of soda was applied in the initial fertilization to insure rapid growth during early fall so that the alfalfa would withstand the winter by establishing a good root system and would be better able to compete with weeds and grasses in early spring. All fertilizers were applied in late winter, before spring growth of alfalfa began. The superphosphate, potash, lime, and borax were mixed and broadcast on the surface.

TABLE I.—KIND AND AMOUNT OF FERTILIZER AND LIME USED PER ACRE.

	Initial fertilization*	Annual fertilization
Dolomitic limestone	6,000	1,000
18% superphosphate	800	600
60% mutiate of potash	200	400
Borax	30	20
Nitrate of soda	100	...

* One-half of the initial fertilizer, except nitrate of soda and boron, was applied when cowpeas were planted; the remainder, on September 15 before the land was harrowed.

An average yield of 4.08 tons of hay per acre has been obtained for the six-year period. The 1943, 1944, and 1945 years were all dry summers. Particularly during the months of July and August, the rainfall was less than one-half of the normal rainfall for those months.

Experiments in the rate of seeding have been conducted by the Department of Agronomy. It was found that 10 to 15 lbs. of seed are ample for seeding when moisture conditions are favorable for germination either in the spring or fall. However, since weeds and grasses are the biggest enemies of alfalfa, the thicker the stand of the alfalfa the less chance there is of weeds and grasses crowding it out. We have found that 25 to 50 lbs. per acre are ample and give a good stand. Fall seeding is more likely to give a good stand and have less difficulty with weeds and grasses than spring seeding since there is an opportunity for the root system of alfalfa to become well established during the first winter.

Taking the average price received by the Georgia farmer for loose alfalfa hay for the period 1943-1948, which was $24.50 per ton, and a yield of 4.08 tons per acre gives a gross return of $99.96 per acre per year. The cost of fertilizer and labor to produce an acre of alfalfa in this experiment was $37, leaving a net income of $62.96 per acre. The labor and fertilizer costs to produce an acre of cotton on the experimental farm was $65 and gave a return of $114.50, based on 1943-48 price of cotton and cotton seed, or a net return of $49.50 per acre. This gives a return of $13.46 per acre in favor of alfalfa. Since the labor requirement of an acre of cotton is approximately four times that of alfalfa, the farmer can grow four acres of alfalfa instead of one acre of cotton and raise his labor profit to $52 per

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TABLE II.—YIELD OF AIR-DRY HAY BY CUTTINGS FOR SIX-YEAR PERIOD 1943-1948.

Cuttings	1943	1944	1945	1946	1947	1948
1st	2,190	2,245	1,811	2,230	2,679	2,303
2nd	2,760	1,315	1,825	2,091	2,727	2,614
3rd	950	1,550	1,540	1,089	2,728	1,814
4th	.....	.....	1,851	741	937	3,740
5th	.....	.....	.....	719	1,416	2,025
Total	5,900	5,110	7,027	6,870	10,487	12,496

Fig. 1. Every Indian has his milpa (corn patch). These milpa are often found on mountain slopes as high as 10,000 feet above sea level. Areas grown up in brush will be burned off and put back in corn after two or three years.

In the Land of the Corn God

By Edgar A. Hodson

Soil Conservation Service, Little Rock, Arkansas

THE Highland Plateau of Southern Mexico and Guatemala was the first Corn Belt in North America, and the natives there rely on corn almost exclusively for their food now as they did in pre-Columbus days.

On a recent trip to Guatemala to study corn production, I flew from Mexico City to get a glimpse of this old Corn Belt from the air. Revealed was a procession of haciendas and villages surrounded by geometrical patterns of corn fields, forests, and barren lands worn out by corn growing long ago. All of these formed an intricate mosaic in mute evidence of the endless labor of countless generations.

Guatemala is a land of corn, earthquakes, and volcanoes—a land steeped in antiquity. This land was the home of the Maya Indians for many centuries before the beginning of the Christian Era. To understand the native Indians of today, it is necessary to know something of their ancient ancestors.

The history of the native Guatemala Indians is old and proud. In 1524 the Spanish Conquistadors under Alvarado conquered all of what is now Guatemala. These Indians represented va-

rious tribes of the Maya who had for their heritage the most advanced civilization on the North American continent. The basis of this brilliant civilization was agriculture—an agriculture limited to the production of corn. The fall of this people seems to have resulted from their total dependence upon this one crop.

Population Mostly Indians

About 65 per cent of the population of Guatemala now is pure Indian. Because of their stubborn resistance to change, they still retain most of the habits and customs of their ancestors. They live in the same kind of thatch-covered houses, speak the same tribal language, and depend upon corn for their existence, just as their forebears did 400 years ago. Every family grows its own milpa or corn patch, and in the thickly settled parts of the Highlands, almost every available foot of ground that can be used is planted to corn. The sides of the mountains are covered with milpa up to altitudes of eight to ten thousand feet. On land so steep, there is real danger of falling out of the field! The Indians generally live in villages, which makes it necessary for many of them to locate their milpa long distances from home, in many cases up to 20 miles or more. And since very few of them have any livestock, this long trip must be made on foot.

A reverence for corn is an integral part of the Mayan history, which really began several thousand years ago when corn first came into existence. Corn similar to that now being grown by these same Indians has been found among the ruins of their ancient temples, so we know it has existed in its present form for a very long time. The manner in which these Indians came into possession of corn is not known, for nowhere on earth has corn ever been found growing in the wild, and corn, as we know it, could not survive without the help of man. It is one of the few cultivated crops that would disappear completely in one or two years if left alone to reproduce itself.

Among the clues to the origin of corn are two botanical relatives still to be found in Guatemala. These are *Teosinte* and *Tripsacum*. The former has some characteristics similar to corn and is related closely enough that hybrids of these two plants can be produced. The corn-teosinte offspring do not provide sufficient evidence to solve the puzzle. Our modern corn plant may have come about as a sport (mutation) which appeared in the related species, or the Indians may have had some Burbank in the ranks of their priesthood who developed it after long years of tedious work in breeding and selection. No one knows.

When the Mayas came to depend upon corn as their principal source of food, they began to burn off patches of ground for their milpa and settled down to live in permanent villages. This farming economy was apparently responsible for a very rapid cultural development which extended from about 300 A. D. to 800 A. D. During this period they built many cities and erected beautiful temples and tall pyramids of massive limestone in honor of their gods. Their social structure consisted of three main classes: The common people (corn growers), the priests (intellectual group), and the nobility (the rulers).

Priests Developed Culture

The permanent settlements gave the priests an opportunity to turn their attention to science. Considering the fact that they had no equipment whatever, they made a remarkable showing. They developed a system of hieroglyphics for recording dates. And, because a knowledge of the seasons was of so much importance in the growing of corn, they calculated the exact length of the lunar month and the solar year. From these data they devised a calendar more accurate than the one we use today. They were the first people on earth to use a place system of numerals comparable to our decimal system.

However, it was based on 20 digits instead of 10 and was cumbersome to use.

It is obvious from the numerous dated monuments that have been found that their system of numbers and the hieroglyphics for recording them was an early development. These monuments apparently were erected periodically to commemorate certain years set aside for celebrations.

This amazing civilization began to decline about 800 A. D. and the once magnificent cities are now crumbling ruins, overgrown with lush tropical vegetation. The exodus from this region took place between 800 A. D. and 1,000 A. D. when the people moved eastward into Yucatan to relocate and build new cities. Not even the exact names of these deserted cities are known, nor the exact reason for their fall. The most logical reason for the decline of this empire is the failure to maintain agricultural production as a result of lowered soil fertility and the lack of equipment with which to cultivate the land.

Lacked Mechanical Development

In spite of the brilliant achievements of their leaders, the Mayas never developed any sort of mechanical contrivances, depending entirely upon the use of their hands for all work. To grow corn, they burned the brush from the land and by the aid of a sharpened stick (their only farming equipment) punched holes in the ground to plant the seed. After a year or two, the invasion of weeds and grasses made it necessary to abandon old corn fields and burn off new land. Several hundred years of such poor land use made it impossible to produce enough corn to sustain the increased population, so the whole people was forced to move to new country.

The religion of the Mayas, like their economy, was rooted in agriculture, and of their various gods, many were agricultural. As would be expected, one of the most conspicuous of these found in the sculpture of the old temples is the Corn God. In further evidence of the antiquity of corn, the Quiche—one of the tribes that inhabits the Highlands of Guatemala, believe that man was made from corn. Rodolpho H. Rivera Ariza, Sub-Director del Instituto Agropecuario Nacional, told me the interesting legend.

According to the Quiche story of creation, in the beginning of time nothing existed but the tranquil sea and a sunless sky. The gods lived as a shin-

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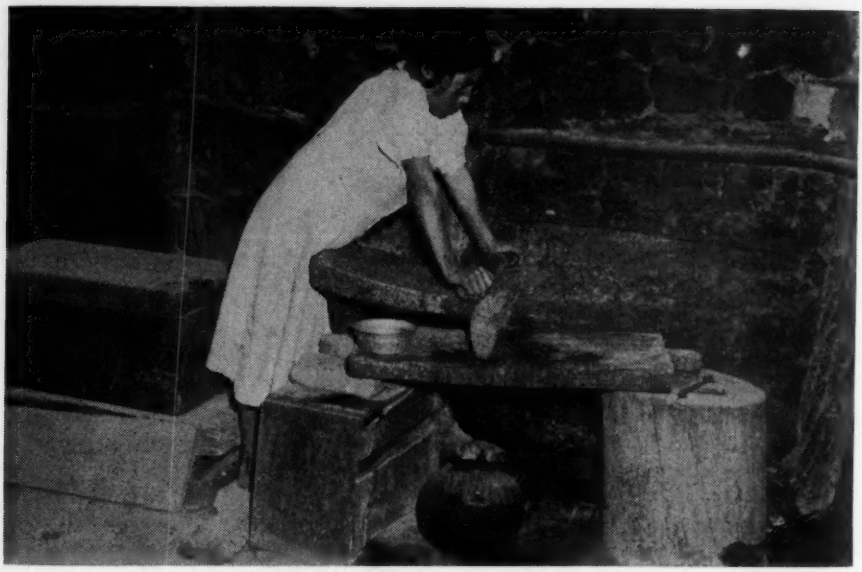
Fig. 2. Young corn god from ruins of ancient Mayan city found at Piedras Negras. This monument was erected in 746 A. D.

Above. **Large hoes such as these are the only tools that the Indians in the Guatemala Highlands use to cultivate their corn plots.**

Below. **Some use is made of every part of the corn plant. This fence is made of stalks; cobs are used for fuel; shucks as a substitute for paper.**

Above. **Seed corn selected at the harvest ritual is stored until the next season by hanging it under the roof of the house.**

Below. **Corn vendor plying his trade on the village square at Momostenango. Shelled corn is weighed out on hand balances.**



Above. **Grinding corn for tortillas. The corn is soaked overnight in lime water and then crushed immediately before using.**

Below. **On market days at Chichicastenango, tortillas are available from the open-air kitchens. Corn in some form comprises about 85% of the total diet.**

The Editors Talk

Business and Agriculture

The businessman in particular and the city dweller in general increasingly are being urged to learn more about the problems of American agriculture if they are to exercise their rights and privileges of citizenship to the best advantage of themselves and of society as a whole. Evidence is abundant that this sound advice is being heeded.

As a striking illustration and of special interest to our Southern readers is the report recently issued by Emory University of Atlanta, Georgia, under the title, "Problems in Land Rehabilitation and Soil Conservation." This is a report of the Business Executives' Research Committee organized by business executives to inform themselves as to what they can do as collaborators in helping to solve these problems of such vital importance to the South. Immediately this can be recognized as a most worthy and commendable enterprise reflecting the wisdom and public-spiritedness of the sponsors and their realization of the fundamental interdependence of business and agriculture if either is to attain and maintain its optimum level of prosperity.

The report deals with the South in general and more specifically with the State of Georgia. It outlines the magnitude of the problem of land rehabilitation following a century of neglect and misuse. While it acclaims the great achievements of the Soil Conservation Service and the various other agencies both state and federal laboring jointly and severally for the benefit of agriculture, it makes clear at the same time that the battle is far from won and cites some of the major obstacles that not only retard progress but may mean ultimate defeat.

Among these several opposing factors, the report's discussions of farm tenancy and the share-cropping system impress us as deserving special mention. While they deal with the subject factually and realistically, the recommendations are tempered to orderly procedures instead of the revolutionary methods of those writers and speakers who become emotional at the expense of the practical.

The share-cropping system is based traditionally on such crops as cotton and tobacco, crops easily divisible between landowner and tenant. Yet the rehabilitation of Southern agriculture calls for diversification, the development of improved pastures and crop rotations, combined with adequate fertilization, practices in which the tenant with his one-year contract takes little or no interest. He gets what he can out of his one crop and then (50% of his number) moves on to some other location. As the report states—"We still have no established pattern for dividing the shares of such commodities as livestock, grazing crops, vegetables, poultry, fruits, and dairy products, despite the fact that the increased production of these commodities is the very heart of successful farm diversification in the region."

Recognizing the "great need for developing a method of distributing income from all types of farm operations on a basis that will be fair and acceptable to both parties," the report makes the following recommendation which we feel warrants full quotation:

"Under the conditions which now characterize the majority of owner-tenant relationships both sides are penalized—the owner by a constantly diminishing crop-producing power of his land and the tenant by a feeling of insecurity on the land he operates. It is not likely that this unprofitable situation can ever be changed satisfactorily under traditional relationships. It does seem possible, however, that some of the undesirable aspects of tenancy can be corrected by written agreements between landowners and land operators based on a program of sound farming practices and extending over a sufficient number of years to assure both parties of fair and profitable returns. Such a change will assure the tenant that he will be on the land long enough to derive assured benefits from conservation farming and will thereby instill in him the much needed sense of security and stability. On the other hand the landowner will stand to gain more in the long run than the tenant, because it is *his* property which is being rehabilitated and conserved. For this reason, initiative to put into operation the new type of agreements should come from the landowners, and they should be encouraged to take the leadership in this instance. Admittedly much persuasion and educational work will be required to induce owners to make the needed shifts in their relations with tenants, but with enough effort it can be done eventually. Generations have come and gone while the present situation was developing, and the whole picture cannot be changed overnight. It will take time and experience by the most foresighted owners to demonstrate that the new relationships can be made to work successfully."

Science and Agriculture

Bringing together many of the continent's outstanding agricultural scientists for exchange of opinion and enlightenment on progress in research, the American Society of Agronomy and the Soil Science Society of America held their 41st annual meeting and the American Society for Horticultural Science, its 46th annual meeting in Milwaukee, Wisconsin, October 24-28. The attendance was one of the largest ever recorded and was well proportioned between the more youthful workers and elders whose lives have been devoted to research and whose judgments are sought and respected for their soundness.

A grower sitting in on sectional meetings and forums probably would have had difficulty in following the discussions, for it was scientific talk with terms well above the ken of those not working in similar fields. He would not, however, have missed the sincerity and earnestness with which these men presented the technical problems to be faced and what is being done to meet them. He would have gained a confidence that his future is in good hands and that sooner or later the knowledge being exchanged would be crystallized and translated into terms and facts for him to put into practice.

We need this confidence and faith in his profession on the part of the grower. Too often the vagaries of weather or economic cycles bring doubts and discouragment. We need also the confidence of the public in the farmer and his ability to meet and overcome his problems. The war and impoverished nations have taught us anew what agricultural production means to civilization.

"There need be no fear whatever of any lack of capacity to feed ourselves permanently in accordance with our desires," Dr. Firman E. Bear, retiring president of the American Society of Agronomy and Research Specialist in Soils at Rutgers University, told a large assemblage. "All we need to do is to make intelligent use of the abundant resources at our command."

It goes without saying that meetings such as these chronicled herewith disseminate the "intelligence" for "use."

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb.	Tobacco Cents per lb.	Potatoes Cents per bu.	Sweet Potatoes Cents per bu.	Corn Cents per bu.	Wheat Cents per bu.	Hay[1] Dollars per ton	Cottonseed Dollars per ton	Truck Crops
	Aug.-July	.....	July-June	July-June	Oct.-Sept.	July-June	July-June	July-June	....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.6	64.2	88.4	11.87	22.55	....
1924.....	22.9	19.0	68.6	149.6	106.3	124.7	12.66	33.25	....
1925.....	19.6	16.8	170.5	165.1	69.9	143.7	12.77	31.59	....
1926.....	12.5	17.9	131.4	117.4	74.5	121.7	13.24	22.04	....
1927.....	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928.....	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929.....	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930.....	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931.....	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932.....	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933.....	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934.....	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935.....	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936.....	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937.....	8.4	20.4	52.9	82.0	51.8	96.2	8.74	19.51	....
1938.....	8.6	19.6	55.7	73.0	48.6	56.2	6.78	21.79	....
1939.....	9.1	15.4	69.7	74.9	56.8	69.1	7.94	21.17	....
1940.....	9.9	16.0	54.1	85.5	61.8	68.2	7.58	21.73	....
1941.....	17.0	26.4	80.7	94.0	75.1	94.4	9.67	47.65	....
1942.....	19.0	36.9	117.0	119.0	91.7	110.0	10.80	45.61	....
1943.....	19.9	40.5	131.0	204.0	112.0	136.0	14.80	52.10	....
1944.....	20.7	42.0	149.0	192.0	109.0	141.0	16.40	52.70	....
1945.....	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946.....	32.6	38.2	122.0	218.0	156.0	191.0	16.70	71.90	....
1947.....	31.3	38.0	156.0	215.0	235.0	241.0	17.30	85.40	....
1948									
November...	30.52	42.8	144.0	198.0	121.0	204.0	18.40	69.00	....
December....	29.63	45.7	154.0	219.0	123.0	205.0	19.10	68.80	....
1949									
January.....	29.27	42.9	166.0	236.0	125.0	202.0	19.80	65.70	....
February....	29.14	29.5	172.0	244.0	112.0	194.0	20.50	53.40	....
March.....	28.74	31.9	174.0	254.0	118.0	198.0	20.00	51.40	....
April.....	29.91	24.7	181.0	275.0	122.0	200.0	19.00	50.30	....
May.....	29.97	32.5	181.0	273.0	122.0	200.0	17.70	50.40	....
June.....	30.13	31.5	175.0	264.0	121.0	186.0	16.40	46.70	....
July.....	30.08	56.5	155.0	283.0	125.0	182.0	15.65	37.50	....
August.....	29.32	44.6	154.0	267.0	118.0	179.0	16.05	44.40	....
September...	29.70	48.7	138.0	230.0	116.0	187.0	16.25	43.50	....
October.....	28.70	47.4	130.0	196.0	109.0	189.0	16.75	41.80	....
Index Numbers (Aug. 1909—July 1914 = 100)									
1924.....	185	190	98	170	166	141	107	147	143
1925.....	158	168	245	188	109	163	108	140	143
1926.....	101	179	189	134	116	138	112	98	139
1927.....	163	207	146	124	132	135	87	154	127
1928.....	145	200	76	134	131	113	95	152	154
1929.....	135	183	189	133	124	117	92	137	137
1930.....	77	128	131	123	93	76	93	98	129
1931.....	46	82	66	83	50	44	73	40	115
1932.....	52	105	55	62	50	43	52	46	102
1933.....	82	130	118	79	81	84	68	57	91
1934.....	100	213	64	91	127	96	111	146	95
1935.....	90	184	85	80	102	94	63	135	119
1936.....	100	236	164	106	163	116	94	148	104
1937.....	68	204	76	93	81	109	74	87	110
1938.....	69	196	80	83	76	64	57	97	88
1939.....	73	154	100	85	88	78	67	94	91
1940.....	80	160	78	97	96	77	64	96	111
1941.....	137	264	116	107	117	107	81	211	129
1942.....	153	369	168	136	143	124	91	202	163
1943.....	160	405	188	232	174	154	125	231	245
1944.....	167	420	214	219	170	160	138	234	212
1945.....	181	366	205	232	198	170	127	227	224
1946.....	263	382	175	249	212	209	141	319	204
1947.....	252	380	224	245	366	273	146	379	249
1948									
November...	246	428	207	226	188	231	155	306	186
December....	239	457	220	250	192	232	161	305	209
1949									
January.....	236	429	238	269	195	229	169	291	282
February....	235	295	249	279	174	219	173	237	285
March.....	232	319	250	290	184	224	168	228	263
April.....	241	247	260	314	190	226	160	223	236
May.....	242	325	260	312	190	226	149	224	213
June.....	243	315	251	301	188	210	138	207	175
July.....	243	565	222	323	195	206	132	166	185
August.....	236	446	221	305	184	202	135	197	174
September...	240	487	198	263	181	212	137	193	205
October.....	231	474	187	224	170	214	141	185	170

Wholesale Prices of Ammoniates

	Nitrate of soda bulk per unit N	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk, per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1924	2.99	2.44	5.87	5.02	3.60	4.25
1925	3.11	2.47	5.41	5.34	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948						
November	3.00	2.20	11.00	10.31	10.44	10.68
December	3.00	2.20	11.52	11.65	11.39	11.46
1949						
January	3.15	2.23	10.29	8.68	11.53	11.53
February	3.19	2.27	9.44	12.36	10.78	10.70
March	3.19	2.27	9.27	12.36	9.64	9.71
April	3.19	2.27	9.22	12.36	9.71	9.87
May	3.19	2.27	9.43	12.36	9.71	9.11
June	3.19	2.28	9.65	13.34	10.02	9.71
July	3.19	2.32	11.07	14.97	11.53	10.78
August	3.19	2.32	11.88	14.49	12.75	12.14
September	3.19	2.32	9.83	14.53	11.53	11.53
October	3.08	2.32	9.94	14.58	11.29	11.65
	Index Numbers (1910-14 = 100)					
1924	111	86	168	142	107	121
1925	115	87	155	151	117	135
1926	113	84	126	140	129	139
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	12	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948						
November	112	77	314	292	310	303
December	112	77	329	330	338	326
1949						
January	118	78	294	246	342	328
February	119	80	270	350	320	304
March	119	80	265	350	286	276
April	119	80	263	350	288	280
May	119	80	269	350	288	259
June	119	80	276	378	297	276
July	119	81	316	424	342	306
August	119	81	339	410	378	345
September	119	81	281	412	342	328
October	115	81	284	413	335	331

Wholesale Prices of Phosphates and Potash* *

	Superphosphate Baltimore, per unit	Florida land pebble 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports[2]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports[2]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports[2]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[2]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1924	.502	2.31	6.60	.582	.860	23.72	.472
1925	.600	2.44	6.16	.584	.860	23.72	.483
1926	.598	3.20	5.57	.596	.854	23.58	.537
1927	.525	3.09	5.50	.646	.924	25.55	.586
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.367
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.498	.706	18.93	.195
1948							
November	.770	4.61	6.60	.375	.720	14.50	.200
December	.770	4.61	6.60	.375	.720	14.50	.200
1949							
January	.770	4.61	6.60	.375	.720	14.50	.200
February	.770	4.61	6.60	.375	.720	14.50	.200
March	.770	3.85	7.06	.375	.720	14.50	.200
April	.770	3.85	7.06	.375	.720	14.50	.200
May	.770	3.85	7.06	.375	.720	14.50	.200
June	.770	3.66	7.06	.330	.634	12.76	.176
July	.770	3.60	5.87	.353	.679	13.63	.188
August	.770	3.60	5.47	.353	.679	13.63	.188
September	.770	3.65	5.47	.353	.679	13.63	.188
October	.770	3.75	5.47	.375	.720	14.50	.200
	Index Numbers (1910-14 = 100)						
1924	94	64	135	82	90	98	72
1925	110	68	126	82	90	98	74
1926	112	88	114	83	90	98	82
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948							
November	144	128	135	68	76	60	83
December	144	128	135	68	76	60	83
1949							
January	144	128	135	68	76	60	83
February	144	128	135	68	76	60	83
March	144	107	145	68	76	60	83
April	144	107	145	68	76	60	83
May	144	107	145	68	76	60	83
June	144	101	145	62	67	53	80
July	144	100	120	65	71	56	82
August	144	100	112	65	71	56	82
September	144	101	112	65	71	56	82
October	144	104	112	68	76	60	83

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1924.....	143	152	143	103	97	125	94	79
1925.....	156	156	151	112	100	131	109	80
1926.....	146	155	146	119	94	135	112	86
1927.....	142	153	139	116	89	150	100	94
1928.....	151	155	141	121	87	177	108	97
1929.....	149	154	139	114	79	146	114	97
1930.....	128	146	126	105	72	131	101	99
1931.....	90	126	107	83	62	83	90	99
1932.....	68	108	95	71	46	48	85	99
1933.....	72	108	96	70	45	71	81	95
1934.....	90	122	109	72	47	90	91	72
1935.....	109	125	117	70	45	97	92	63
1936.....	114	124	118	73	47	107	89	69
1937.....	122	131	126	81	50	129	95	75
1938.....	97	123	115	78	52	101	92	77
1939.....	95	121	112	79	51	119	89	77
1940.....	100	122	115	80	52	114	96	77
1941.....	124	131	127	86	56	130	102	77
1942.....	159	152	144	93	57	161	112	77
1943.....	192	167	151	94	57	160	117	77
1944.....	195	176	152	96	57	174	120	76
1945.....	202	180	154	97	57	175	121	76
1946.....	233	202	177	107	62	240	125	75
1947.....	278	246	222	130	74	362	139	72
1948								
November.	271	262	239	134	94	311	144	72
December..	268	262	237	137	94	336	144	72
1949								
January...	268	260	233	136	97	313	144	72
February..	258	257	231	136	99	309	144	72
March....	261	258	231	134	99	290	144	72
April.....	260	258	229	134	99	291	144	72
May.....	256	257	227	134	99	293	144	72
June.....	252	257	223	134	99	304	144	65
July.....	249	256	225	140	100	349	144	68
August....	245	254	222	143	100	372	144	68
September.	249	253	225	138	100	334	144	68
October...	243	251	222	138	98	331	144	72

* U. S. D. A. figures. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

[2] All potash salts now quoted F.O.B. mines only: manure salts since June 1941, other carriers since June 1947.

**** The weighted average of prices actually paid for potash is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. Since 1937, the maximum discount has been 12%. Applied to muriate of potash, a price slightly above $.471 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Nutrient Deficiency Signs in Plants," Ga. Exp. Sta., Univ. System of Ga., Experiment, Ga., Press Bul. 612, July 7, 1949, L. C. Olson.

"Fertilizer Tonnage Sold in Indiana as Reported by Fertilizer Manufacturers from July 1, 1948, to June 30, 1949," Ind. State Chemist, Lafayette, Ind., mimeo. rpt., F. W. Quackenbush.

"Effect of Late Applications of Nitrogen and Potassium on Potato Yields," Ky. Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., Bul. 529, March 1949, E. M. Emmert.

"Official Report Maryland Inspection and Regulatory Service — Feed, Fertilizer, and Lime Issue," College Park, Md., Issue No. 211, Aug. 1949.

"A Progress Report of Fertilizer Trials on the Fayette and Tama Soils in Southeastern Minnesota—1948," Agr. Exp. Sta., Univ. of Minn., St. Paul, Minn., Soil Series No. 26, April 1949, J. M. MacGregor and E. R. Duncan.

"Fertilizer Inspection and Analysis; Fall 1948," Agr. Exp. Sta., College of Agr., Univ. of Mo., Columbia, Mo., Bul. 529, Sept. 1949, J. H. Longwell, H. J. L'Hote, and R. C. Prewitt.

"North Carolina Fertilizer Recommendations for Field Crops—1949," Agr. Ext. Serv., N. C. State College of Agr., Univ. of N. C., Raleigh, N. C., E. R. Collins.

"1949 Spring Sales of Fertilizers in Ohio," Dept. of Agron., Ohio State Univ., Columbus, Ohio.

"Fertilizer Report for the Year 1948," Pa. Dept. of Agr., Harrisburg, Pa., Gen. Bul. 624, Vol. 32, No. 3, May-June 1949.

Soils

"From Public Burden to Public Benefit — The Story of Marinette County's Land Program," Agr. Exp. Sta., Univ. of Wis., Madison, Wis., Bul. 483, Jan. 1949.

"Physical Land Conditions in Kit Carson County, Colorado," SCS, U.S.D.A., Washington, D. C., Physical Land Survey No. 43, 1949.

"Keep Crop Residues on the Surface of the Ground," SCS, U.S.D.A., Washington, D. C., SCS-TP-80, May 1949, J. H. Stallings.

"Soil Management for Tree-fruits and Truck-crops in the Southern Interior of British Columbia," Dept. of Agr., Province of British Columbia, Victoria, B. C., Canada, Hort. Cir. No. 76, 1949.

"Our Remaining Land—We Can Use It and Save It," SCS, U.S.D.A., Washington, D. C., AIS No. 79, June 1949.

Crops

"Growing Strawberries in the Home Garden," Agr. Ext. Serv., Univ. of Calif., Berkeley, Calif., Cir. 151, May 1949, R. E. Baker.

"Alfalfa Seed Production, Hemet Valley, Riverside County, 1948," Agr. Ext. Serv., Univ. of Calif., Farm Advisor Off., Riverside, Calif., Wallace Sullivan and O. A. Harvey.

"Bunch Grape Production in Georgia," Ga. Exp. Sta., Univ. System of Ga., Experiment, Ga., Cir. 160, Aug. 1949, F. F. Cowart and J. E. Bailey.

"Making A Lawn in Georgia," Ga. Exp. Sta., Univ. System of Ga., Experiment, Ga., Press Bul. 613, Aug. 31, 1949, L. V. Crowder.

"Temporary Winter Grazing in Georgia," Ga. Exp. Sta., Univ. System of Ga., Experiment, Ga., Press Bul. 614, Sept. 12, 1949, L. V. Crowder and O. E. Sell.

"Thirty-first Annual Report of Illinois State Department of Agriculture — 1949," Springfield, Ill.

"Report on Agricultural Research for the Year Ending June 30, 1948," Agr. Exp. Sta., Iowa State College, Ames, Iowa.

"Balanced Farming and Family Living in Kansas," Agr. Ext. Serv., Kans. State College, Manhattan, Kans., Cir. 212, April 1949.

"Carrying Science to Farm People," Ext. Serv., Univ. of Md., College Park, Md., 34th A. R., 1948.

"Annual Report for the Fiscal Year Ending June 30, 1948," Agr. Exp. Sta., Univ. of Mass., Amherst, Mass., Bul. 449, Sept. 1948.

"Improved Varieties of Farm Crops," Agr. Ext. Serv., Univ. of Minn., St. Paul, Minn., Ext. Folder 22, Rev. March 1949.

"Varietal Trials of Farm Crops," Agr. Exp. Sta., Univ. of Minn., St. Paul, Minn., Misc. Rpt. 6, Feb. 1949, H. K. Hayes, E. R. Ausemus, J. O. Culbertson, J. W. Lambert, and R. G. Robinson.

"Highlights of the Work of the Mississippi Experiment Station," Miss. State College, State College, Miss., 61st A. R., 1948.

"Sweet Sudan Grass Increases Milk Production in North Mississippi," Agr. Exp. Sta., Miss. State College, State College, Miss., Info. Sheet 430, March 1949, R. T. Landrum and S. P. Crockett.

"Alfalfa and Sweetclover Silage," Agr. Ext. Serv., Univ. of Nebr., Lincoln, Nebr., E. C. 173 Rev., May 1949.

"Better Tobacco Plants," Agr. Ext. Serv., N. C. State College, Raleigh, N. C., N. C. Ext. Folder 70, Rev. March 1949, R. R. Bennett and S. N. Hawks Jr.

"Oregon's Seed Crops, 1936-1947," Ext. Serv., Oreg. State College, Corvallis, Oreg., Ext. Bul. 694, Nov. 1948, B. E. Black.

"Comparative Costs of Uprooting Old Apple Trees," Agr. Exp. Sta., Pa. State College, State College, Pa., P. R. No. 8, April 1949, L. W. Linvill.

"Early Defoliation Often Increases Winter Injury of Sour Cherries," Agr. Exp. Sta., Pa. State College, State College, Pa., P. R. No. 13, July 1949, W. C. Kennard.

"Year Book of the Department of Agriculture of the State of South Carolina, 1947-1948," Columbia, S. C.

"Our Corn Program in South Carolina," Ext. Serv., Clemson Agr. College, Clemson, S. C., Cir. 338, June 1949, H. A. Woodle and P. S. Williamon.

"Rushmore Spring Wheat," Agron. Dept., Agr. Exp. Sta., S. D. State College, Brookings, S. D., Bul. 394, April 1949, J. E. Grafius and V. A. Dirks.

"Sixtieth Annual Report, 1947," Agr. Exp. Sta., Univ. of Tenn., Knoxville, Tenn.

"Strawberries—A Way to Grow Them in Utah," Ext. Serv., Utah State Agr. College, Logan, Utah., Ext. Bul. 175, April 1949, C. D. Ashton.

"Garden to Save Wheat, Save Meat, Save the Peace," Ext. Serv., W. Va. Univ., Morgantown, W. Va., 1949.

"Growing Strawberries in Wisconsin," Ext. Serv., Univ. of Wis., Madison, Wis., Stencil Cir. 237, Rev. Feb. 1949, J. G. Moore.

"Grass Silage Saves Feed and Cuts Costs . . . ," Ext. Serv., Univ. of Wis., Madison, Wis., Stencil Cir. 277, Rev. Feb. 1949, G. Bohstedt, W. H. Peterson, F. W. Duffee, and N. N. Allen.

"Collecting & Planting Seeds of Wisconsin Cone-bearing Trees," Ext. Serv., College of Agr., Univ. of Wis., Madison, Wis., Stencil Cir. 286, Feb. 1949, R. W. Abbott.

"How to Repair Girdled Fruit Trees," Ext. Serv., Univ. of Wis., Madison, Wis., Stencil Cir. 290, April 1949, C. L. Kuehner.

"Ladino Clover for Better Pastures," Ext. Serv., Univ. of Wis., Madison, Wis., Cir. 367, Rev. May 1949, H. L. Ahlgren and F. V. Burcalow.

"Extension—Alert Helper in Ranching, Farming, Homemaking," Agr. Ext. Serv., Univ. of Wyo., Laramie, Wyo., Bul. 14.

"Range Reseeding," Wyo. Range Management, Agr. Exp. Sta., Univ. of Wyo., Laramie, Wyo., Issue No. 8, Feb. 1949, A. C. Hull, Jr.

"Handling and Shipping Southern-grown Tomato Plants," U.S.D.A., Washington, D. C., Cir. No. 805, April 1949, E. V. Miller, W. D. Moore, H. A. Schomer, and E. K. Vaughan.

"Grazing Spring-Fall Sheep Ranges of Southern Idaho," U.S.D.A., Washington, D.C., Cir. No. 808, May 1949, J. F. Pechanec and G. Stewart.

"Report on the Agricultural Experiment Stations, 1948," Office of Exp. Stations, Agr. Research Admin., U.S.D.A., Washington, D. C., Jan. 1949.

"Home Vegetable Gardening in the Central and High Plains and Mountain Valleys," U.S.D.A., Washington, D. C., Farmers' Bul. No. 2000, March 1949, M. F. Babb and J. E. Kraus.

"Questions and Answers about Grazing on National Forests," Forest Serv., U.S.D.A., Washington, D. C., AIS No. 80, May 1949.

"Multiflora Rose for Living Fences and Wildlife Cover," U.S.D.A., Washington, D. C., Leaf. No. 256, 1949, W. L. Anderson and F. C. Edminster.

"Progress Report, 1937-1947, Dominion Exp. Sta., Beaverlodge, Alberta; Progress Report, 1936-1947, Dominion Exp. Farm, Agassiz, B. C.; Progress Report, 1937-1947, Dominion Exp. Farm, Brandon, Manitoba; Progress Report, 1936-1947, Dominion Reclamation Sta., Melita, Manitoba; Progress Report, 1937-1946, Dominion Exp. Sta., Harrow, Ont.; Progress Report, 1936-1946, Dominion Exp. Sta., Normandin, Que.; Progress Report, 1936-1946, Dominion Exp. Sta., Melfort, Sask.; Progress Report, 1937-1946, Dominion Exp. Substation, Regina, Sask.; Progress Report, 1937-1946, Dominion Exp. Farm., Indian Head, Sask.," Can. Dept. of Agr., Ottawa, Can., 1949.

Economics

"1949 Outlook—Wheat, Flax, and Soybean," Agr. Ext. Serv., Univ. of Minn., St. Paul, Minn., Ext. Pamph. 167, Dec. 1948, M. K. Hinds and R. V. Backstrom.

"Procedure for Land Reclassification in Montana," Agr. Exp. Sta., Mont. State College, Bozeman, Mont., Bul. 459, Feb. 1949, H. G. Halcrow and H. R. Stucky.

"Adjustments in Maine Agriculture and Farm Prices—A Graphical and Statistical Presentation," Agr. Exp. Sta., Univ. of Maine, Orono, Maine, Misc. Publ. No. 615, Dec. 1948, C. H. Merchant and J. E. McKenney.

"Maryland Farm Crop Statistics 1939-1948," Agr. Exp. Sta. and Ext. Serv., Univ. of Md., College Station, Md., Supplement 1 to Bul. No. X 3.

"The Labor Supply and Mechanized Cotton Production," Agr. Exp. Sta., Miss. State Col-

lege, State College, Miss., Bul. 463, June 1949, Dorothy Dickens.

"Cost of Operating Tractors, Trucks, Trailers and Combines in the Yazoo-Mississippi Delta, 1947," Agr. Exp. Sta., Miss. State College, State College, Miss., Cir. 147, April 1949, J. P. Gaines and G. B. Crowe.

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"Suggestions for Organizing a County Crop Improvement Association," Ext. Serv., Univ. of Nebr., Lincoln, Nebr., E. C. 185, June 1949, C. R. Porter.

"Postwar Farm Incomes in the Pecos Valley, New Mexico," Agr. Exp. Sta., N. M. College of A & M Arts, State College, N. M., Press Bul. 1028, April 1949, H. B. Pingrey.

"Postwar Farm Incomes in Mesilla Valley, New Mexico," Agr. Exp. Sta., N. M. College of A & M Arts, State College, N. M., Press Bul. 1029, June 1949, H. B. Pingrey.

"Let's Discuss—Fixed and Flexible Price Supports—Programs and Problems Pertaining to Agriculture," Dept. of Rural Econ. and Rural Soc., Ohio State Univ., Columbus, Ohio, No. 1, April 1949, M. G. Smith.

"Cost of Producing Apples and Pears, Hood River Valley, Oregon—Progress Report No. II," Agr. Exp. Sta., Oreg. State College, Corvallis, Oreg., Sta. Cir. of Info. No. 456, June 1949, G. W. Kuhlman, A. E. Irish, and D. C. Mumford.

"Farm Earnings on Selected Farms in Clatsop County, Oregon, 1948," Agr. Exp. Sta., Oreg. State College, Corvallis, Oreg., Sta. Cir. of Info. No. 457, June 1949, M. H. Becker, L. E. Warner, and D. C. Mumford.

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"Part-time Farming in the Knoxville Farm-industrial Area of East Tennessee," Agr. Exp. Sta., Univ. of Tenn., Knoxville, Tenn., Bul. No. 210, May 1949, H. J. Bonser.

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"Cost of Handling Texas Citrus, Fresh and Processed, with Comparisons for Florida, 1946-47," Agr. Exp. Sta., Texas A & M College System, College Station, Texas, Bul. 709, June 1949, K. A. Fugett and J. K. Samuels.

"Keeping Up on the Farm Outlook," Ext. Serv., Institute of Agr. Sciences, State College of Wash., Pullman, Wash., Ext. Cir. No. 136, July 27, 1949, Karl Hobson.

"Keeping Up on The Farm Outlook," Ext. Serv., State College of Wash., Pullman, Wash., Ext. Cir. No. 138, Aug. 31, 1949, K. Hobson.

"Consumption of Food in the United States, 1909-48," Bu. of Agr. Econ., U.S.D.A., Washington, D. C., Misc. Publ. No. 691, Aug. 1949.

"Origin, Structure, and Functions of the U. S. Department of Agriculture," Office of Information, U.S.D.A., Washington, D. C., Document No. 1, Rev. Sept. 1, 1949.

"Important Recent Achievements of Department of Agriculture Scientists," Office of Information, U.S.D.A., Washington, D. C., Document No. 6, Rev. Oct. 1, 1949.

"Agricultural Economic and Statistical Publications," Bu. of Agr. Econ., U.S.D.A., Washington, D. C., BAE-AESP—7/49 4500, July 1949.

"Soybeans Harvested for Beans — Acreage, Yield and Production, 1947 and 1948, by Counties for 18 Principal States," Bu. of Agr. Econ., U.S.D.A., Washington, D. C., July 1949.

"Marketing Northwestern Onions — Summary of the 1948-49 Season, Oregon, Washington, Idaho," Fruit and Veg. Branch, Prod. and Mktg. Admin., U.S.D.A., Washington, D. C., June 1949, C. J. Hansen.

"Marketing California Grapes and Raisins, 1948 Season," Fruit and Veg. Branch, Prod. and Mktg. Admin., U.S.D.A., Washington, D. C., July 1949.

"Marketing Arizona Salt River Valley Lettuce — Summary of 1948 Fall and 1949 Spring Seasons," Fruit and Veg. Branch, Prod. and Mktg. Admin., U.S.D.A., Washington, D. C., May 1949, C. B. Miller and W. F. Hines.

"Agricultural Statistics, 1948," U.S.D.A., Washington, D. C., 1949.

"Fruits (noncitrus)—Production, Farm Disposition, Value, and Utilization of Sales, 1947, and 1948," Bu. of Agr. Econ., U.S.D.A., Washington, D. C., July 1949.

"An Economic Study of Family-sized Farms in Puerto Rico—II. Monserrate Farm Security Administration Farms, 1943-44, 1944-45," Agr. Exp. Sta., Univ. of Puerto Rico, Rio Piedras, P. R., Bul. No. 78, March 1949, Guillermo Serra and Manuel Piñero.

A man with a wonderful vocabulary is one who can describe a shapely girl without using his hands.

Prof.: And now we find that X is equal to zero.

Student: Gee whiz, all that work for nothing.

How Hoosiers Grow Record Tomato Yields

By Thomas W. Higgins

Purdue University, Lafayette, Indiana

"THIS is my advice to you, anyone can grow tomatoes if he uses some common sense and plenty of fertilizer," Roscoe Fraser was saying as I entered his office where he was just ending a phone call from a farmer who wanted some advice on growing tomatoes for a local cannery. My interview with Mr. Fraser, Tomato Specialist at Purdue University, was to get some information on the large yields that Indiana growers are turning out.

First he spread out some records of the U. S. Won Club Champion. This club is composed of the farmers who wish to produce a larger quantity and a better quality of tomatoes for Indiana canners. It was organized by the Purdue Horticultural Department cooperating with the County Agricultural Agents, the Indiana Canners' Association, local canning companies, and the farmers who contract acreage with canning companies.

Mr. Fraser placed in front of me the record of a 17-year-old boy, Carlton Anderson, who was graduated from Clay Township High School in Miami County in 1947. Anderson had taken vocational agriculture in high school, and this was his first year on his own in tomato growing. He grew the crop on a 50-50 basis on the Schryler Lesh farm, which is located near Bunker Hill.

Anderson had 5½ acres of tomatoes and produced an average yield of 16.2 tons per acre—85.2 per cent U. S. No. 1's and two-tenths per cent culls. This is how he produced this record-breaking crop. First, 400 pounds of 3-18-9 fertilizer per acre were applied to the land about the first of May. Then the field was plowed to a depth of eight inches. When the plowing was done, the field was double-disced four times, harrowed twice, and 300 pounds of 3-12-12 fertilizer per acre were broadcast on the surface of the plowed ground by using a wheat drill. Then at planting time 250 pounds of 6-12-6 per acre were applied in the rows.

The field was direct seeded with Indiana Baltimore seed at the rate of 1½ pounds per acre. The rows were 40 inches apart, and the plants were thinned out to 18 inches apart in the rows. The crop was cultivated twice: first with a two-row cultivator and next with a one-row cultivator. There were two airplane dustings of seven per cent insoluble copper to help keep the crop free from diseases and insect attack.

After I had looked over this record, Mr. Fraser said, "You see this lad knew the value of plenty of fertilizer, and he applied good management, which was largely responsible for this crop."

The record of Kash Kissick, Route 5, New Castle, disclosed one of the other high yields. He was the 1947 winner of the Double Tonnage Tomato Club, a companion to the U. S. Won Tomato Club.

Mr. Kissick had upland soil of Miami type. He applied one ton of manure per acre before plowing, and at planting time he had 400 pounds of 3-12-12 applied with the plants in the row. The average yield per acre for his 7½ acres was 16.42 tons.

Another high yield was obtained by Don Caley, who was a junior in Union Center high school and a veteran 4-H club member of four years. He held the honor of being the 1947 Reserve

Double Tonnage Club Champion with a yield of 13.21 tons per acre in spite of the fact that he had some late blight in his field.

Don also used plenty of fertilizer, applying 600 pounds of 3-12-12 per acre with a grain drill before the Indiana Baltimore plants were set. He wasn't afraid of too much work, and his record shows that he cultivated the crop five times and hoed the field by hand three times.

In answer to what he thought about the size of future yields of tomatoes, Mr. Fraser replied, "I expect big things. The farmers are just finding out how well the practice of good growing will pay off when harvest time comes. With the added use of potash on tomato crops, we can expect almost anything. One thing for certain, we are going to see some record-breaking high yields in these two clubs this year."

Leaf Analysis Shows Plant Needs

Without even a whisper, a leaf can convey a fairly reliable report on the food material needs of the tree. The message shows up in chemical analysis.

Dr. O. A. Alben, soil technologist of the U. S. Department of Agriculture stationed at the pecan field laboratory, Shreveport, La., says that leaf analysis probably tells more than any other method about the mineral nutritional requirements of the pecan tree.

Analyses made over a period of years furnish scientists at the laboratory with data showing when the amount of a mineral element such as nitrogen, phosphorus, or potassium, in the pecan leaves is low, average, or high. Further information on deficiency symptoms has been obtained in analyses of leaves from pecan trees growing in sand cultures and fed solutions supplying known amounts of the various nutrients. On the basis of these studies, the scientists can now use leaf analysis to diagnose quickly nutrient deficiencies in the pecan tree.

Why the Push on Potash

(*From page* 15)

Another reason why potash has become an increasingly critical element is the fact that in the early days and even now we have been using fertilizers relatively rich in phosphate, and this has resulted in pumping potash out of our land at an accelerated rate. I tell farmers who are using rock phosphate that they should purchase some pure potash or mixtures such as 0-10-20 or 0-9-27 to go along with their rock phosphate.

Too, the liming of our soils has tended to accentuate the need for potash. It is a strange thing that the use of agricultural lime and the neutralizing of soil acidity should bring about changes in the soil that tend to slow down the rate at which potash is becoming available. Deficiencies of boron, manganese, iron, and possibly certain other trace elements also may follow in the wake of the liming of our soils. It appears that applying lime to our soils and raising the pH or soil reaction to the neutral point bring about a condition where potassium and certain other elements become less available to growing crops. I urge farmers to lime their acid soils but not to overlime. We believe it best to keep our soils a little on the acid side.

The 17 million tons of lime that have been poured onto Wisconsin farms in the last 15 years have no doubt been a factor responsible in part for the

diminishing supplies of available potassium. This liming did, for a few years, result in substantial increases in the production of alfalfa, clover, and other crops, and in turn, these bigger crops of legumes pulled just that much harder on the supplies of potash. Liming an acid soil tends to increase the availability of soil phosphorus, and thus the pull on potash is still further increased.

Wisconsin farmers are now applying a substantial tonnage of commercial fertilizer (404,121 tons in 1948), and this large tonnage of fertilizer is helping to offset the unbalancing effect of the heavy applications of lime. But still we are not getting as much potash as we want or should be using. The ever-increasing production of potash from domestic sources, along with the small quantities coming from France and Germany, will before long really give our crops all the potash they need or can make use of economically.

The Use of Gypsum . . .

(*From page* 18)

removing the gypsum from the surface of the furrow, the high per cent sodium water again will cause this soil to seal and prevent deep percolation.

Even though the mass of soil between the furrows contains large quantities of gypsum, it will be of little use in preventing sealing adjacent to the furrows. To increase infiltration, it will be necessary to re-work the soil and refurrow the land to bring soil containing gypsum in contact with the water. The other means of overcoming this sealing effect is the addition of gypsum to the irrigation water as was done in this experiment. The methods used in the experiment are not practical for field use, Fig. I. Other methods, however, are practical and have been widely used. The first field treatments were applied by shoveling the gypsum into the standpipe, or putting it around the outlet valves of the pipeline. These methods gave fair results, but were not satisfactory.

Farmers began improvising machines for this purpose by using potato fertilizer hoppers and other home-made devices. Some of these were built in such a manner that paddle wheels provided the power. For several years, this type of implement was used. However, no organized effort or standard machine was developed for this purpose.

In 1946, the Kern County Agricultural Extension Service designed a gypsum applicator for metering gypsum into irrigation water, Fig. 2. This first machine worked on the principle of a potato fertilizer hopper or manure spreader, in that a moving belt carried the load. The gypsum was metered by the speed of the belt and by the opening in the front of the hopper. The belt on the first machine was 28 inches wide and the hopper 26 inches square. Since gypsum has the property of bridging, the hopper was built with straight sides. The machine was geared to move the belt at the rate of about 8 inches per minute. The reduction on this original machine was obtained by the use of a Boston gear reduction and various belts, pulleys, and chains. The unit was powered by a 110-volt electric motor. The belt was supported at each end by 6-inch rollers mounted on roller bearings. The bearings at one end were movable, allowing for adjustment of the belt. Two-inch roller bearings were evenly spaced beneath the hopper to support the load of gypsum. The machine was designed to sit over an open ditch or standpipe and meter gypsum into the irrigation water.

Since this original machine was devel-

oped, several other machines have been designed, using similar or, in some cases, completely different ideas. Most machines now being built have a mixing vat which may be attached or come as a separate unit. This mixing vat takes a small portion of water from the pump discharge pipe, mixes it with the gypsum metered out, and pumps the suspension back into the discharge. This type of applicator is used where the irrigation system is operated under pressure.

Many applicators have been designed and built by the farmers themselves. Others are designed and built by various machine shops for the farmers. These machines may also be used to apply soluble dry fertilizer to the water.

The quantity of gypsum used in the irrigation water will depend somewhat upon the purpose for which the material is being applied. Some use has been made in applying excess gypsum to overcome an alkali condition. In this discussion, we will consider only the amount of gypsum necessary to correct the high percentage sodium irrigation water.

Where poor penetration is a result of a high sodium percentage irrigation water, as experienced in Kern county, gypsum can be applied to reduce the percentage of sodium. Water below 50 per cent sodium has not generally caused a great deal of trouble with infiltration. On the other hand, where trouble is experienced a great portion of the water is over 50 per cent sodium. Therefore, as an arbitrary figure, we choose to use 50 per cent as the dividing line.

Tables have been prepared giving the amount of gypsum required to correct the water when the percentage and quantity of sodium are known. Table II gives the pounds of gypsum required per hour to reduce various percentages of high sodium waters to 50 per cent for a 1,000 gallon per minute flow. The table is prepared using milligram equivalents of sodium per liter and gives the amount of gypsum necessary to reduce 60, 70, 80, 90, and 100 per cent sodium waters to 50 per cent. Assuming that we have a 90 per cent sodium water and one milligram equivalent of sodium per liter, which is one more or less commonly found in Kern county, it would require 38 pounds of gypsum an hour for each 1,000 gallons per minute discharge to correct the water to 50 per cent sodium. The quality of gypsum required for each milligram equivalent increase in sodium is 38 pounds an hour per 1,000 gallons a minute discharge.

Table III is prepared in the same manner as Table II, except the figures indicate the pounds of gypsum required per acre-foot of water to reduce the sodium content to 50 per cent. As-

TABLE II. POUNDS OF GYPSUM (APPROXIMATE) REQUIRED PER HOUR TO REDUCE VARIOUS PERCENTAGES OF HIGH SODIUM WATER TO 50 PER CENT SODIUM WATER WITH A FLOW OF 1,000 GALLONS PER MINUTE

Per Cent Na	* Milligram Equivalents Sodium per Liter									
	1	2	3	4	5	6	7	8	9	10
100	43	86	129	172	215	256	301	344	387	430
90	38	76	114	152	190	228	266	304	342	380
80	32	64	96	128	160	192	224	256	288	320
70	25	50	75	100	125	150	175	200	225	250
60	14	28	42	56	70	84	98	112	126	140

* Milligram equivalents per liter is a common term used by chemists in reporting water analyses. Sometimes the reported analysis is in parts per million, and to convert the sodium to milligram equivalents, divide by the factor 23. For example: 46 P.P.M.÷23=2 milligram equivalents per liter.

TABLE III. POUNDS OF GYPSUM (APPROXIMATE) REQUIRED PER ACRE-FOOT OF WATER TO REDUCE HIGH SODIUM WATERS TO A CONTENT OF 50 PER CENT

Per Cent Na	Milligram Equivalents Sodium per Liter									
	1	2	3	4	5	6	7	8	9	10
100	233	466	699	932	1,165	1,398	1,631	1,864	2,097	2,330
90	206	412	618	824	1,030	1,236	1,442	1,648	1,854	2,060
80	173	346	519	692	865	1,038	1,211	1,384	1,557	1,730
70	136	272	408	544	680	816	952	1,088	1,224	1,360
60	76	152	228	304	380	456	532	608	684	760

suming that three acre-feet of water are used to grow a crop, then three times the amount shown in Table III should be applied.

The data presented in Tables II and III are for the correction of water being used on land considered good agriculturally, but having its infiltration rate impaired by the use of high sodium percentage water.

The correction of high sodium water is limited to relatively low salt concentration. A high total salt and high sodium percentage water requires a large amount of gypsum to make the correction. Difficulty will be experienced in dissolving the gypsum at these high concentrations, and the cost will be high. It is questionable whether waters having a sodium content in the higher concentrations (Tables II and III) should be corrected. According to Table III, to reduce a 90 per cent sodium water to 50 per cent, with a concentration of 10 milligrams equivalent sodium would require approximately a ton of gypsum per acre-foot of water. It may not be necessary to reduce the sodium to a 50 per cent level to get improved infiltration. As indicated in Table I, a reduction in percentage sodium by 20-30 per cent may be sufficient to give adequate water penetration.

This material does not apply necessarily to alkali land, even though it may be useful in that connection. The work was done on the sandy loam soils of Kern county. The results obtained indicate that the amount of gypsum necessary to improve the infiltration rate is much less when applied in the water rather than directly to the soil. When the gypsum is applied to the soil, quite frequently it is thrown into the beds where it can be of little value in aiding infiltration. That quantity which is left in the furrow is soon leached, does its work, and is gone. Frequently, the gypsum applied to the soil is of very coarse texture or contains a large number of lumps, which render it less valuable as a soil conditioner.

Gypsum used in the irrigation water should be of high grade (90 per cent purity), if pipe lines are involved. The impure gypsum can be applied through the meter to open ditches, but should be used with caution in pipe lines, due to the settling out of impurities. The figures shown in Tables II and III are based upon 100 per cent gypsum. If the gypsum is lower than 90 per cent, some allowance should be made, and proportionately larger quantities of material used.

The rate at which the soil improves varies considerably from ranch to ranch. Some farmers have obtained very good results with the first irrigation. These instances, however, have been few. Normally, it takes about three irrigations before a great deal of improvement can be seen in the infiltration rate. Frequently, in an effort to obtain a more rapid response, a larger quantity of gypsum than these indi-

cated by the table are applied at first. In that case, the limiting factor would be the amount of gypsum that the water would dissolve. After the initial application, only the amount of gypsum necessary to correct the water need be applied.

It is thought that the proper method is to correct all water pumped from the well. This will not allow the soil to become hard and seal over again during the growing season of any specific crop.

Summary

Field tests were run in Kern county, California, using gypsum in the irrigation water. The tests were carried out on ranches having water penetration problems. These ranches use water pumped from irrigation wells. This particular water is of low mineral content. Sodium salts, however, constitute a large portion of the minerals present. The infiltration rate of the water on these fields was increased by the use of gypsum in the irrigation water. The lowest average increase was 33 per cent obtained on Field No. 126. The highest average percentage increase was 168 on Field No. 122. The amount of gypsum added on these two fields was 187 pounds and 297 pounds per acre-foot of water, respectively, Table I.

Tables have been worked out for use in calculating the amount of gypsum necessary to correct irrigation water when the sodium percentages and quantities are known. One table is based on gallons per minute discharge and another on the basis of one acre-foot of water.

Field applications of gypsum to irrigation water are now being made by many farmers in Kern county. Metering machines are being used in most cases. The machines are being built by farmers and various machine shops. Their use has become a general practice in the soft water areas of Kern county.

In the Land of the Corn God

(*From page* 27)

ing circle of light. These creator gods possessed great thoughts and, in time, they began to speak to each other. At their command, the "Earth" appeared above the waters of the sea. They next created mountains, valleys, trees, grass, rivers, and lakes. Later they created animals, birds, and reptiles. The gods were dissatisfied because, up to this time, they had created nothing capable of thought and worship. So they decided to create superior beings and made the first men from damp clay. These clay creatures turned out to be clumsy, ugly, and stupid and they melted away when they got wet. So the gods destroyed all these beings by water and then set about to make a more suitable man. This second man was made of wood. He was less clumsy and more durable than the clay man. He could talk and reproduce, but he had a fatal spiritual defect—he had no feelings and he did not worship his creators. The gods attempted to destroy all of the wooden men by a rain of fiery liquid and monsters. But the legend says that a few of these men escaped and became monkeys.

Finally the fox, the coyote, and two birds (the parakeet and the falcon) brought word to the gods that they had found corn; that it was a marvelous plant with white and yellow ears, and it would be suitable material for them to use. The gods decided to try again, and they made four men of corn. But this time they had done their work too

well. These men were beautiful creatures, clear-seeing and capable of understanding everything. They were so much like their creators that it was feared they would not be sufficiently humble. To correct this, a mist was passed over their eyes to prevent them from seeing too clearly. At last a satisfactory creature had been made to populate the earth. He could speak, think, and feel, but he was not too wise. And now the world is populated with white men, yellow men, and red men—because corn produces white, yellow, and red ears.

Pre-planting Ritual

Corn is so much a part of the lives of these people that they observe some sort of ritual from the time the seed is blessed in the church, when it is planted, cultivated, and harvested, through the final operation of selecting the seed for the next year's crop. The ceremony varies considerably from tribe to tribe, but each follows more or less the traditional rites that have been handed down to them for thousands of years.

Planting begins in March and extends into May, depending upon the rains. Before planting, the people purify themselves by burning incense and by making peace with their neighbors. On a Sunday before planting, a special mass is celebrated in church where the seed is carried to be blessed. At the church in Chichicastenango, each family selects a spot on the floor where their seed are placed, and then they surround their seed with lighted candles, incense, and flower petals. Finally, they kneel in a circle around the seed and pray.

The night before planting, the men burn incense and sprinkle the field with aguardiente (an alcoholic beverage of about the same potency commonly known in this country as "white mule") while they watch and pray at home with lighted candles. In the morning, the women take candles and festive foods to the fields for the planters. The candles are placed at points representing the four directions, and then, after the planting is done, the feast is served.

When the corn is harvested, another ritual season begins. The relatives and friends of each family help to gather the corn. The selection of the seed is of prime importance, though the process could hardly be called scientific. In some instances, only the corn from the center of the field is chosen (Corazon del Maiz—Heart of the Corn). The finding of twin ears is a cause for great rejoicing, for in them is the spirit of corn and the assurance of a good crop next season. One of the twin ears is saved for seed and the other is placed as a thank-offering before the figure of the family's household saint. On occasion, the twin ears may be buried in the pile of harvested corn as an example to the others to reproduce in like manner.

Long ago, the corn was piled on the ground as harvested, and the Indians gathered around to wait patiently for the Corn God to make certain ears jump out of the pile. These were invariably chosen for seed. In some localities, the largest ear found at harvest time is fastened to a rocket and discharged. If the ear reaches a great height, it is taken as a token that the corn will be sold for a high price.

Cultural methods have changed but little since the Spanish Conquest. In areas where land is plentiful, the brush is cut and burned to prepare the milpa for planting. A sharpened stick is still used for planting the seed which is carried to the field in a fiber bag. The sole change that has been made to date is that a large hoe is now used for cultivation of the plants.

In thickly settled areas, corn is grown on the same land year after year. In other areas, after two crops, a new milpa is cleared and the old one is allowed to grow up in brush, to be cleared again after a few years of rest.

In some cases, short sections of elderberry branches are planted under each hill of corn. These decay readily and supply a small amount of plant food.

A large bean, similar to the sort we know as horse bean, is commonly grown in each hill of corn. Although these beans are grown for food, they are no doubt of some help in maintaining soil fertility.

Cultivation consists mainly in pulling dirt up to the plant, forming a hill 12 to 18 inches high. There is a striking lack of uniformity in the plants which are mainly slender. The leaf sheaths are almost always found with a dense hairy covering, varying from green to nearly black. The color of the kernels may be white, yellow, red, or blue.

It can readily be seen that the large amount of hand labor required for growing the crop leaves little time for any other work during the corn-growing season. The men spend the greater part of their time producing the crop, and a very large proportion of the housewife's time is consumed in grinding the corn by hand and in cooking it. In spite of the limited variety of food consumed, these Indians are remarkably strong and energetic. They are very industrious, good natured, and friendly —these modern subjects of the Corn God.

Irrigation . . . in Southeast

(*From page* 12)

Texas has made tremendous strides in irrigation during the last 10 years and much of it has been on cotton. This has been due to the comparatively low rainfall, the growth of citrus and truck crop production in the Rio Grande Valley, and developments in other areas where irrigation is feasible.

In 1939, Texas had 843,839 acres under irrigation. In 1948, the irrigated area had grown to 3,038,006 acres. The Texas Extension Service reports that the State's irrigated acreage should continue on the increase, certainly for the years immediately ahead.

Texas, of course, is an exception. It has large, expensive citrus and truck crop areas that are absolutely dependent on irrigation. Without it, the land which is now high-priced, would be good for little except grazing. To produce its truck and citrus, Texas depends largely on irrigation.

The Southeast does not have to have irrigation. It is not an absolute necessity if we just wish to maintain the status quo. Statistics will show that the Southeast has what the Chamber of Commerce would call "ample rainfall." The vast network of rivers, creeks, lakes, and ponds has been there from time immemorial. However, generations of farmers have let the good water flow right by fields that were literally parched for want of moisture. Now, at long last, we see encouraging signs of an awakening to the possibilities that irrigation offers throughout the entire area. We see it in the Carolinas, in Georgia, in Florida, and other sections.

These signs mark the way we are headed. However, irrigation generally in this area is new, so new that we should go slowly. We need much research on the subject, for the ramifications of irrigation do not end with putting some water on the land. There is much to learn of timing, methods, how much, which crops, and so on.

We never learn by waiting. We must start; go slow; and not attempt too much at first. Then we can build on the findings of experience and experiment.

Interest in irrigation is growing, not because the Southeast has to have it, but because farsighted farmers want to achieve the natural goal of every good farmer—"a quantity of quality product on the same acre."

Alfalfa . . . in the South

(*From page* 24)

cotton acre, provided he has land for increasing the alfalfa acreage to four times that of his cotton acreage. On this basis alfalfa is a much better cash crop than cotton on the average Georgia farm.

Of course, all soils on which cotton is grown are not suitable for alfalfa production. According to soil survey maps of the State, there are approximately 1,800,000 acres of land in Georgia that are well adapted to it. There is less hazard from erosion, leaching, and soil deterioration with alfalfa than there is with cotton production, but it takes heavy applications of lime, superphosphate, and potash to maintain high yields of alfalfa.

Alfalfa can be grown successfully and economically in the Piedmont, Appalachian, and Limestone Valley soil regions of the Southeast and on the heavier, well-drained sandy loam soils of the Coastal Plains, particularly those soils with heavy sandy clay or clay subsoils. Five million acres of alfalfa properly fertilized in the Southeast will put its livestock business on a profitable basis.

Alfalfa can be harvested for hay or grazed if precautions are taken so as not to over-graze in dry weather, late fall, or mid-winter. Alfalfa has given a higher yield on our experimental farm than lespedeza or kudzu. It is a perfect hay crop and is ideal for handling with mechanical equipment. It is a labor saver. The average seeding of alfalfa should last from four to 10 years, making it cost less for seed and labor than any of our annual hay crops, and it affords year-round soil protection. The South has a "Green Gold"—so why not use it?

Some Fundamental Principles

(*From page* 22)

monly the best and most inexpensive method to open up the subsoil. For best soil condition the usual requirements might be summarized as follows: (1) A proper balance between intertilled and hay or pasture crops, (2) Winter cover crops where practical and economically sound, (3) Return to the soil of all crop residues as far as practical, (4) Good care and use of farm manures, and (5) Growing a deep-rooted legume where needed and then at least once in an average rotation.

Referring to Figure 2 and studying the virgin and compact soil illustrations, it is easy to see that under virgin soil conditions, the soil has been made open and porous by years of root penetration and organic accumulations. Speaking from the strictly physical viewpoint, it is this type of condition in soils which our farm operations should seek to emulate. In contrast to the virgin soil, a glance at the cylinder on the right shows that continuous cultivation has burned out the organic matter, and use of heavy farm machinery has pressed the soil particles close together resulting in a compact soil layer. This type of soil compaction shuts off the downward movement of water, limits the amount of air cir-

culating, and restricts root development of plants to that thin margin between the compacted area and the soil surface. In looking at this situation from the standpoint of soil improvement or soil building, the problem is to employ every possible means, not only to prevent these undesirable compactions from forming, but when formed, to quickly and effectively break them up, thus permitting air, water, and root development in soils to function in a natural and more effective manner.

In the opinion of the experts, there are two ways of breaking up compacted soil areas: It can be done either by specially designed machinery, by nature, or both. It is generally believed that the best way to break up the plowsole is to provide soil conditions by liming and fertilization to grow deep-rooted legumes, and let nature take her course.

Mechanical Methods

Mechanical means for breaking up soil compaction have been employed in many parts of the country. The only trouble about mechanical equipment is, first, its cost, which in many cases, especially for the small farmer, is prohibitive; and second, on many types of soils the effect of deep tillage for breaking up the soil compactions is temporary. Where conditions are extremely bad to start with, it may be necessary to purchase or hire deep-tillage machinery in order to make soil conditions reasonably favorable for the establishment of a deep-rooted legume. For best all-around improvement of the physical condition of compacted soils, both the mechanical and natural means for correction may need to be employed. Machinery, no doubt, does the job more quickly than the use of deep-rooted legumes, but over a long period of time, and that is how we must view the problem of soil building, the best bet lies in the benefits from a well-planned rotation.

While farmers and soil scientists still have a great deal to learn about soil aeration and its effects on plants, the basic facts all point to the advisability of getting air both to roots of plants and to soil organisms which are so beneficial to growth. Whether we use a factory-made tool or a plant furnished by nature in accomplishing this matters little so long as we effect the desired movement of both moisture and air in soils and always toward the deeper parts of the soil.

Conservation Logic

In a recent report from the U. S. Department of Agriculture we were told that six billion dollars' worth of lime, phosphorus, potash, and nitrogen is lost from the country's soils each year. That is a third as much as our crops are worth. Less than one-sixth is replaced in the form of fertilizers. It would appear that we are still making a living by mining our soils. Our lime deposits are practically inexhaustible—nitrogen can be manufactured and for all practical purposes is inexhaustible. Phosphorus and potash deposits, on the other hand, are known to be limited. It behooves us, therefore, to do everything possible to use these supplies carefully. Unnecessary losses naturally mean higher fertilizer needs to grow crops and this means faster exhaustion of the scarce plant-food materials. To cut mineral losses it will be necessary to employ the following: (1) Prevent erosion, (2) keep the ground covered with growing crops, (3) develop well-balanced rotations, (4) store manure well or spread at once, (5) use all the lime that is needed, and (6) use phosphorus and potash as needed for legumes and soil-protecting crops.

Terraces, sod waterways, and dams are required on many farms to prevent erosion. When required, they are necessary first steps. Other lands can be used safely only for the growing of grass or trees. But on all lands used for crops or pasture, many other steps are required for successful maintenance of soil fertility. Many of these steps have to be repeated perhaps every year. And they have to be combined with

others in a system for permanent soil fertility if needs for national production and individual farm success are to be met.

Details of systems necessarily vary greatly between areas, but certain essentials common to all are: (1) Land that is intensively cropped must be kept in good physical condition. If not, rain water runs off instead of soaking in, carrying the topsoil with it. Such land gets water-logged or puddled, is hard to work, suffers from drought, and fertilizers fail to give full results. (2) The supply of essential available minerals—lime, phosphoric acid, potash, and nitrogen must be kept at an adequate level. Shortage of any one may sharply limit yields and economic returns. High acre yields like mass production in industry are the secret of success in either undertaking. High acre yields are also the secret of success in erosion control and conservation farming. The doubling and trebling of the yields on the less erodible lands through adequate liming and fertilizing will make possible the return of the more erodible lands to forest and permanent pasture. This need not mean less food, but much more and better food for all.

. . . N. E. Green Pasture Program

(*From page* 8)

advantage, as has brome grass over timothy, under the dry conditions which prevailed throughout June, July, and August in many sections of New England. I have been accused, personally, of being partial to ladino clover, and perhaps the accusation is just. I still believe, however, that ladino clover can safely be depended upon in our grassland dairy farming rotations in the average season, for 1949 was far from that. Apparently, these 18 men feel the same way, since their acreage now growing ladino was just over one acre per animal unit on the farms.

Sometimes, one has to over-emphasize a point to get it across. That may be what we have done with ladino. Its wide soil and climatic adaptations are sufficient to recommend it universally in this area. But just because it is adapted so widely is no reason farmers shouldn't produce alfalfa on land that is adapted to it. And we suspect there will be more of a swing into alfalfa as a result of our experiences in 1949.

The drought has created a great deal of interest in irrigating pastures and hay fields, and several systems utilizing sprinklers have been installed throughout New England. Their use is limited to those farms where a water supply is available or can easily be made available. While it is too early to say what the future of irrigation will be, the preliminary installations have given good results, as would be expected in a season when in the three hottest months there were less than five inches of effective rainfall. With irrigation come new problems of fertilization and management, how often to fertilize, how much water to apply, and similar unanswered questions. Those farmers who watered their fields through the season fertilized after each harvest, if hay or grass silage was the objective, and some fertilized lightly after each pasturing where the harvesting was left to the animals. Irrigating should and will increase the acre amounts of fertilizer needed.

It is very difficult to criticize the methods of these 18 top men, as it was in 1948. If there is any one place where they can be criticized, it is in the

lack of providing emergency crops for the hotter, drier portion of the year. It was interesting to note that of the 18, only seven had seeded any Sudan grass or Japanese millet for August feed, and these seven planted but 31 acres. Ten of these 31 acres were on a farm in the extreme northern part of New Hampshire, in a region where the rainfall was distributed well enough and in an amount so that the owner did not need emergency feed. At the moment, there is much more interest in growing rye or wheat for late fall or early spring pasture than in these midsummer insurance crops. Seven of the men had 82 acres of rye or wheat for spring feed and several of them were planning for late fall feed from one of the small grain crops. Grazing of oats when used as a nurse crop is, of course, fairly common practice.

The other observation comes as a result of comparing 1949 with previous years in respect to pasture management. These men are pointing the way to more skillful procedures, not only in soil fertility practices but in other phases of management which enable them to get more feed from their acreage. Clipping the pastures to keep them vegetative was more commonly practiced this year than in 1948. More fencing is being done, resulting in smaller acreages pastured at a time and less waste of feed. More emphasis is being placed upon water and shade, and several of these top men have developed loafing pastures adjacent to their small rotated pastures, with water and shade in the loafing area so the cows will come out of the lush ladino areas and drink and rest.

More men, too, are spacing their fertilizer applications to better advantage, thereby producing their feed when it is most needed. All but three of these 18 farmers topdressed some of their land after the first crop was cut or pastured, and the amount of land so treated amounted to 30 per cent of the total acreage on all the farms. This indicates progress.

Green Pastures, although it started in a small way with only 87 farmers enrolled in New Hampshire in 1947, has spread throughout New England, with 1,800 men entering in 1948 and 2,700 in 1949. Besides New England, many other states are trying out the idea. They will find, no doubt, as we have here, that a Green Pastures program, properly organized and executed, is one of the best educational tools yet devised to teach the principles of better pasture and forage production and management.

No Quitter!

(*From page* 5)

from that which the selfish man inhabits. He possesses a new sense which enables him to behold objects which the selfish cannot see. His enjoyments penetrate his heart and do not merely remain on the surface of the mind."

And finally, we all have little respect for a fellow who hangs tenaciously to his little nook of business or profession beyond the time when he can gracefully ease out and make room for others whom he has trained and counseled. I know a minister who did that and a high-school principal who stuck to his job too long. Both cases were sorry examples of stubborn pride. In neither case would a resignation and retirement been amiss and in both cases the quitters would have been honored and praised by their successors and their associates. Yet they both hung on too long, got into a row or two, showed petty atti-

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tudes, and barely escaped dismissal. All because they had the wrong outlook and by their defiance made painful what might otherwise have been a pleasant shift to purposeful achievement on retirement.

A man who retires with all his mental and spiritual powers intact and with enough life in his legs to take him places without anxiety is in for a happy time of it. He can drop into the old "roundhouse" occasionally just to kid the characters who work there like slaves when he is free, or maybe to give them a bit of sound advice when they ask it.

HE can take his grandchildren by the hands and toddle off with them to learn anew those things he has long since forgotten, what with red tape and dreary routine. He can help some neighbor plan and erect anything from a garage to a new house, or join some community effort that has in it some real abiding goal—with most of the members too busy to see it through, leaving there a space for him to fill. It's always valuable for any community to have men of maturity and experience and sense who can take firm hold of half-finished, immature visions and push them toward completion. Such a chance is a boon to a fellow who is supposed to have "retired."

As one looks around the country and dips into history, it becomes more and more apparent that age in years has never stopped the folks with soul and talent and character. So when we say of them that they have "quit" or "retired" we mean it's time to keep watch of them because they are loose at last and ready to render those things that the old grindstone kept their nose out of for countless working years.

So don't let me catch you saying you want to "die in harness." Just pray aloud to have them take off the harness, and the blinders and the check rein with it. Then kick up your heels and prance off to refresh yourself in green pastures.

AVAILABLE LITERATURE

The following literature on the use of fertilizers in profitable soil and crop management is available for distribution. We shall be glad to send these upon request and in reasonable amounts as long as our supply lasts.

Circulars

Tomatoes (General)
Asparagus (General)
Vine Crops (General)
Sweet Potatoes (General)
Better Corn (Midwest) and (Northeast)
The Cow and Her Pasture (General)

Reprints

F-3-40 When Fertilizing, Consider Plant-food Content of Crops
S-5-40 What is the Matter with Your Soil?
II-12-42 Wartime Contribution of the American Potash Industry
J-2-43 Maintaining Fertility When Growing Peanuts
Y-5-43 Value & Limitations of Methods of Diagnosing Plant Nutrient Needs
FF-8-43 Potash for Citrus Crops in California
A-1-44 What's in That Fertilizer Bag?
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P-3-45 Balanced Fertility in the Orchard
Z-5-45 Alfalfa—the Aristocrat
GG-6-45 Know Your Soil
OO-8-45 Potash Fertilizers Are Needed on Many Midwestern Farms
ZZ-11-45 First Things First in Soil Fertility
H-2-46 Plow-sole Placed Plant Food for Better Crop Production
T-4-46 Potash Losses on the Dairy Farm
Y-5-46 Learn Hunger Signs of Crops
AA-5-46 Efficient Fertilizers Needed for Profit in Cotton
WW-11-46 Soil Requirements for Red Clover
ZZ-12-46 Alfalfa — A Crop to Utilize the South's Resources
A-1-47 Fertilizing Vegetables by Applying Fertilizer to Preceding Cover Crop
G-2-47 Research Points the Way for Higher Corn Yields in North Carolina
I-2-47 Fertilizers and Human Health
P-3-47 Year-round Grazing
T-4-47 Fertilizer Practices for Profitable Tobacco
Y-5-47 Increasing Grain Production in Mississippi
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E-2-48 Root Rot of Sweet Clover Reduced by Soil Fertility
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O-4-48 Legumes Improve Drainage and Reduce Erosion
R-4-48 Needs of the Corn Crop
X-6-48 Applying Fertilizers in Solution
AA-6-48 The Chemical Composition of Agricultural Potash Salts
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OO-11-48 The Use of Soil Sampling Tubes
SS-12-48 Hubam Sweetclover
TT-12-48 Season-long Pasture for New England
A-1-49 Organic Matter Puts New Life in Old Soils
B-1-49 Hardening Plants with Potash
C-1-49 Military Kudzu
D-1-49 Permanent Pastures in South Carolina
E-1-49 Establishing Bermuda-grass
F-2-49 Fertilizing Tomatoes for Earliness and Quality
H-2-49 Wise Land Use Increases Farm Income in the South
I-2-49 Maintaining the Productivity of Irrigated Lands
J-2-49 Increasing Tung Profits with Potassium
K-2-49 Four West Virginia Veterans Top 100-bushel Corn Yield
L-3-49 The Development of the American Potash Industry
M-3-49 Better Louisiana Corn
N-3-49 Are You Shortchanging Your Corn Crop?
O-3-49 Undeveloped Soil Resources of the Southeastern Atlantic Coastal Plain
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Y-6-49 Heredity Plus Environment Equals a Corn Crop
Z-6-49 The Search for Truth
AA-6-49 Recommended Practices for Growing Peanuts
BB-8-49 The Red Hills of the Piedmont Need More Green Blankets
CC-8-49 Efficient Vegetable Production Calls for Soil Improvement
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A New Book—

DIAGNOSTIC TECHNIQUES

For

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by Michael Peech

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by Ivan E. Miles and J. Fielding Reed

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Edited by Herminie Broedel Kitchen, Associate Editor, Soil Science

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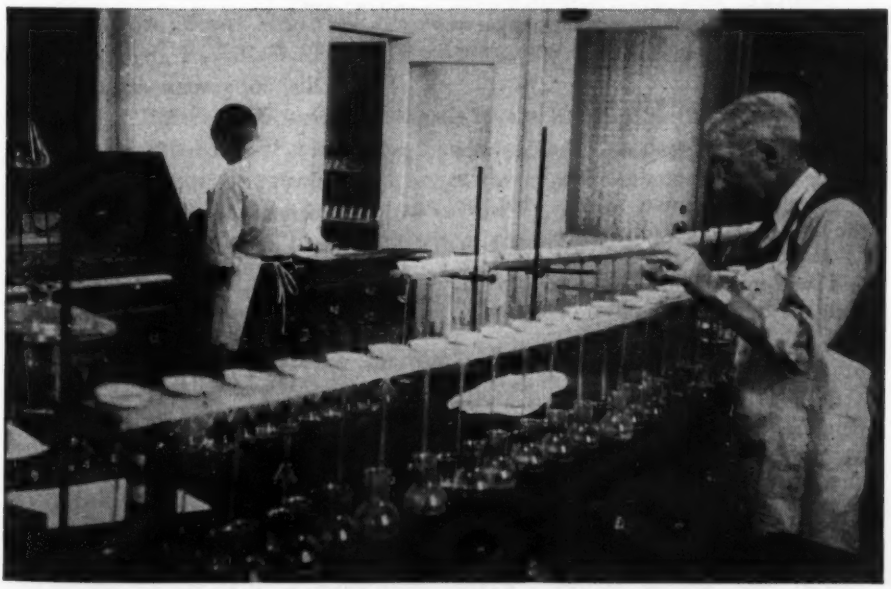
Nitrate tests can be made at the base of the leaf midrib without destroying the entire plant. This is an important consideration in making numerous tests on small experimental plots. The height of the plant at which nitrates are present as well as the intensity of the blue color gives an indication of the nitrate status of the plant.



Equipment used in a well-developed laboratory for soil analyses.

Everyone in the Dean's office in the local law school was very busy. It was the beginning of the school year. The Dean was the busiest of anybody. The phone rang, and when the Dean answered, a sweet young voice said.

"Is this the gas co.?"

The Dean roared, "No, this is the law school!"

To which the sweet young voice replied: "Well, I didn't miss it so damn much, did I?"

* * *

Tommy came home proudly from his first day at school.

"What did you learn in school?" asked his mother.

"Nothing," said Tommy, then, seeing the look of disappointment on her face, he added, "But I learned a lot during recess!"

* * *

A hillbilly, back from the war, was sitting in the village store one day when a traveling salesman asked what he thought of military life.

"I liked the drinkin', card-playin', and wimmin right well," he replied, "but the fightin' was plum dangerous."

* * *

Once upon a time there was a boy penguin and a girl penguin who met at the Equator. After a brief but charming interlude, the boy penguin went north to the North Pole; the girl penguin went south to the South Pole.

Later on, a telegram arrived at the North Pole, stating simply: "Come quick—I am with Byrd."

Parson: "Goodbye and God bless you. Be careful that the rowdies in town don't play tricks on you."

Newlyweds: "Don't worry, Parson, they won't catch us napping."

* * *

EPITAPH

"Ma loved Pa, Pa loved wimmen; Ma caught Pa with two in swimmin'. Here lies Pa."

* * *

Oldest political story:

A negro, listening to the speech of a perspiring candidate at a country picnic, remarked:

"He sho' do recommend hisself powerful high."

* * *

Time tells on a man—especially a good time.

* * *

Father: "Why shouldn't I be friendly with my secretary? We work together every day. It's only logical."

Mother: "Wouldn't 'biological' be a better word, dear?"

* * *

IN LONDON

"You ladies ought to sit a little closer," said a male strap-hanger in the bus. "According to the Act of Parliament—every passenger is entitled to 18 inches of seating space."

"You can't blame us," replied a matron tartly, "if we are not constructed according to the Act of Parliament."

FERTILIZER BORATE

more economical

FOR AGRICULTURE

Authorities have recognized that the depletion of Boron in soil has been reflected in limited production and poor quality of numerous field and fruit crops.

Outstanding results have been obtained with the application of Borax in specific quantities, or as part of the regular fertilizer mix, improving the quality and increasing the production of alfalfa and other legumes, table beets, sugar beets, apples, etc.

The work and recommendations of the State Agricultural Stations and County Agents are steadily increasing the recognition of the need for Boron in agriculture.

Boron is a plant food element and is commonly obtained from Borax since the element does not occur in the pure form. Fertilizer Borate is a sodium borate ore concentrate containing 93% Borax.

Fertilizer Borate was placed on the market by the makers of "20 Mule Team Borax" as a fertilizer grade product to save cost of refining and hence to supply Borax at the lowest cost.

Fertilizer Borate is packed in 100 lb. sacks. Address your inquiries to the nearest office.

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THE PLANT SPEAKS

A new four-reel series of 16 mm., sound, color films which may be booked independently or in any combination. They may be used to best advantage when shown at least one day apart and in the following sequence:

THE PLANT SPEAKS THRU DEFICIENCY SYMPTOMS pictures soil depletion, erosion, and deficiency symptoms on plants. (Running time 25 min. on 800-ft. reel.)

THE PLANT SPEAKS, SOIL TESTS TELL US WHY depicts taking soil samples on the farm and the interpretation of soil tests. (Running time 10 min. on 400-ft. reel.)

THE PLANT SPEAKS THRU TISSUE TESTS shows the value of tissue testing and the procedure for testing plant tissues in the field. (Running time 14 min. on 400-ft. reel.)

THE PLANT SPEAKS THRU LEAF ANALYSIS evaluates leaves in plant growth and leaf analysis in determining fertilizer needs. (Running time 18 min. on 800-ft. reel.)

We shall be pleased to loan these films to agricultural colleges, experiment stations, county agents, vocational teachers, responsible farm organizations, and members of the fertilizer trade.

OTHER 16MM. COLOR FILMS AVAILABLE FOR TERRITORIES INDICATED

Potash in Southern Agriculture (South)
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Bringing Citrus Quality to Market (West)
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Potash Deficiency in Grapes and Prunes (West)
New Soils from Old (Midwest)
Potash Production in America (All)
Save That Soil (All)
Borax From Desert to Farm (All)

IMPORTANT

Requests should be made *well in advance* and should include information as to group before which the film is to be shown, date of exhibition (alternative dates if possible), and period of time of loan.

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